IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF TEXAS

MARSHALL DIVISION

KAIST IP US LLC, PLAINTIFF VS. SAMSUNG ELECTRONICS CO., LTD; SAMSUNG ELECTRONICS AMERICA, INC.; SAMSUNG SEMICONDUCTOR, INC; SAMSUNG AUSTIN SEMICONDUCTOR, LLC;, GLOBALFOUNDRIES, INC.; GLOBALFOUNDRIES U.S., INC.; AND QUALCOMM, INC., DEFENDANTS	)( )( )( )( )( )( )( )( )( )( )( )( )( )(	 CASE NO. 2:16-CV-1314-JRG-RSP MARSHALL, TEXAS JUNE 12, 2018 12:37 P.M.

TRIAL TRANSCRIPT OF JURY TRIAL

BEFORE THE HONORABLE JUDGE RODNEY GILSTRAP

UNITED STATES CHIEF DISTRICT JUDGE

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P R O C E E D I N G S

(Jury out.)

COURT SECURITY OFFICER: All rise.

THE COURT: Be seated, please.

MR. SOOBERT: Your Honor, may I address the sealing of the courtroom?

THE COURT: You may, counsel.

MR. SOOBERT: Thank you, Your Honor.

We -- the Defendants have taken a look at the remaining demonstratives that are in the materials, and it appears to us that there's no need to seal the courtroom any further, as long as we stay at that level of detail with the demonstratives.

Of course, the underlying technical documents remain subject to the protective order. And they're AEO materials, and I've spoken with counsel for Plaintiff, and

they'll speak for themselves, but we've reached an accommodation that he doesn't expect to get in the underlying technical information at this time. And I think with that representation, there's no need to seal the courtroom any further on Dr. Kuhn's examination.

THE COURT: All right. Thank you for that indication of things.

What does Plaintiff say in response?

MR. CHOUNG: Your Honor, it's true for the demonstratives, the content of what's being displayed is exactly what's in the demonstratives. I won't be going any further in terms of any other pages of the cited exhibits, and Dr. Kuhn's testimony will reflect what's on the slides.

THE COURT: All right. Then based on those representations, I unsealed the courtroom just before we broke for lunch. And unless either side moves the Court to seal the courtroom going forward, we'll leave it unsealed as it is.

MR. SOOBERT: Thank you, Your Honor.

THE COURT: Is there anything else we need to take up before we bring the jury back in?

MR. CHOUNG: Not from us, Your Honor.

THE COURT: All right. Mr. Choung, you may go to the podium and prepare to continue your direct examination.

And if you would, please try to speak up. I may be

getting hard of hearing, but the Plaintiff's counsel seems to be talking awfully soft in this trial to me.

MR. CHOUNG: Yes, Your Honor.

THE COURT: The affliction does not seem to have spread to the Defendants' table, though.

All right. Let's bring in the jury.

COURT SECURITY OFFICER: Rise for the jury.

(Jury in.)

THE COURT: Welcome back from lunch, ladies and gentlemen. Please have a seat.

We will continue where we left off just before lunch with the Plaintiff's direct examination of Dr. Kuhn.

And Mr. Choung, you may continue with your examination.

MR. CHOUNG: Thank you, Your Honor.

KELIN KUHN, PH.D., PLAINTIFF'S WITNESS, SWORN

DIRECT EXAMINATION (CONTINUED)

BY MR. CHOUNG:

Q. Welcome back, Dr. Kuhn.

So we left off with -- I believe we went through Claims 1 through 5?

A. That's correct, sir.

Q. All right. So now we're starting on Claim 6?

A. Yes, sir.

Q. All right. And so let's look at your analysis for

Claim 6?
A. So Claim 6 is another dependent claim. It has all the elements we talked about in Claim 1. And it's another of these two-part claims where we're talking about an electrical parameter, the contact resistance, and then we're talking about the relation and size of the contact region to the metal layer. So there's some size parameters. And we're going to be talking about the contact resistance being reduced, and we're going to be talking about some relationships in size between the contact region and the Fin and the gate links.
Q. Dr. Kuhn, is the size specification met by the accused devices?
A. Yes. And I'm going to set up the model here for the jury.
Recall the source/drain regions, I'm going to put them back on.
You'll notice the triangular shape, the contact is going to drop right on top like that. And the region where the metal contact hits the source/drain region is the contact region.
So that's the metal, that's the contact region, and that's the source/drain region.
And you can see here just in the model the Fin for sizing.

Now, if you look to the Defendants' documents and look first to see PX-0208, what we have is you see that same triangular region that I've shown in the model here. And then there's the metal layer up here. And then that red line is the contact region, and the model is flat just as representative, but that's the real thing in the picture.

And so here's the contact region. And then in the background, the way the TEMs are made is there's a shadowing effect so that you can actually see the width of the TEM in relation to the contact region in this picture. So it's very much like the model shows.

And then you can just see visually that the contact region is larger than the width of the Fin.

On the bottom are some written specifications, the bottom is for Samsung; top is for GlobalFoundries.

And you can see the dimension here, which is the same dimension we're showing this dimension right here that's in red. They have the number for this dimension of 17.

Now, I'm going to stay this once verbally, and then I'll show you the numbers. 17 happens to be larger than either the top or the bottom width of the Fin. So, again, we see the -- we have a situation where the contact region is larger than the Fin.

And if I can have the next slide, I'll run through

the numbers.
Q. And those numbers are coming from PX-265?
A. Yes, they are.
Q. All right.
A. Thank you, sir.
And so as I said, the size of the contact region is 17, the width of the Fin in that particular image varies from 4 to about -- sorry, from 7.5 to about 14. And so 17 is greater than 7.5 or 14, so the size of the contact region does meet this claim.
Q. Now, Dr. Kuhn, in this portion of your slide, how did Professor Lee achieve these features?
A. These features were done by what's called selective epitaxy.
Q. And does that account for the shape of the contact -- the contact region -- the source/drain in the -- in the figures there?
A. Yes. Dr. Lee specifies the possibility of using different materials for the epitaxy. And in particular, he specifies the possibility of using a material called silicon-germanium. Silicon-germanium has the interesting property that when you grow it, it's kind of like a crystal that you have in salt or something. It makes this faceted shape, and so you can see very clearly that there's epitaxial growth under that material.

Q. Now, this -- the size of the contact region, this is your calculation that you did, Dr. Kuhn?
A. Yes, sir.
Q. All right. Now, do the Defendants also meet the contact resistance portion of the limitation?
A. Yes, sir. I did some simulation for this, and on the vertical axis is the resistance, and on the horizontal axis is the length of the contact region. And I have two plots for two different widths.

Remember, the spec talks both about length and width. So I did the plot both ways. We have length here and two different widths.

And what you can see is as the length is increased for a constant width, the resistance improves. And as the width is increased for a constant length, the resistance is improved. And the combination is improved as well.

Now, of course, you can read this plot backwards, too, that if the length is decreased or the width is decreased, the contact resistance degrades.
Q. And is this confirmed by Defendants' engineers?
A. Yes. Dr. Samavedam confirms this, and he confirms it in the form of as you decrease the size of the contact region in the devices, it would increase the contact resistance.
Q. And so what is your conclusion on this Claim 6?
A. The Defendants have this element in their devices, and

they infringe this claim. They infringe both parts, so I'm checking both parts off, and I'm turning the claim green and checking it off.

Q. Now, what are the next claims that you looked at?

A. I looked at Claim 11 and 12 together, and I'm going to spend a moment -- I want the jury to notice this above spec and below spec, above the reference level and below the reference level. And I'm going to show this to the jury, and then we'll come back and talk through this.

So what this is going to be talking about is that this source/drain region, the bottom of the source/drain region you're going to want to look at. And it will either be above this top of the second oxide region or below the second oxide region. And one claim is one way, and one claim is the other. And so you'll notice Claim 11 is the one above, and Claim 12 is the one that's below.

In each case, it's a goodly distance. It's 15 nanometers in the model. It's that much either way, so it's a large distance.

Q. And what does your analysis for Claim 11 show?

A. So for Claim 11, I looked at some of the Defendants' documents, and in particular this is Samsung Document PX-0864. And I looked at it for the NMOS device. That's the NMOS part of the CMOS circuit. And I computed two numbers.

It turns out the LPE process and LPP are a little bit different. So for NMOS, it's -- for LPE, it's about 3 nanometers above the second oxide layer. And for LPP, it's about 5 nanometers above.

So for the jury, what's going on in Claim 11 in the Defendants' devices, it's above but by a small amount, not a very big amount.

Q. And the measurements you -- you -- the measurements you made and calculated, they fall within the 50-nanometer range?

A. Yes, they do. The spec is from 0 to 50, and 3 and 5.5 fall in that range.

Q. And what did your analysis show for Claim 12?

A. It turns out in Claim 12, the PMOS component of the CMOS circuit infringes. This is, again, from PX-0864. In this case, LPE and LPP are slightly different. LPE is about 9 nanometers below, and LPP is about 7 and a half nanometers below. And that's well within the 0 to 50-nanometer spec. In this case, for the jury, it's below by, you know, a small amount, not a huge amount, small amount, but well within the spec.

Q. And is your analysis here representative of all of the 14-nanometer transistors and the devices based on those that you're analyzing in this case?

A. Yes. This is one of the few claims for which the

difference between LPE and LPP makes a difference. Turns out the Fin height is slightly different between the two technologies, and I've taken that into account in this -- these two calculations.

Q. So even with that difference, it still infringes?

A. Yes.

Q. So what's your conclusion on these two claims, 11 and 12?

A. For both these claims, the Defendants' devices infringe, in one case for NMOS and one case for PMOS. I'm checking both of them off, and I'm turning both of them green as infringed.

Q. What's the next claim that you analyzed, Dr. Kuhn?

A. The next claim is Claim 15. This is the devices claimed in Claim 1, and this has the two top corners of the Fin active region being chamfered through an oxidation and etching or, parentheses, an annealing process. I will speak to both the word "chamfering" and -- "or (and)" here for the Court's decision.

Q. Would you remind us of how the Court defined this claim?

A. Yes. For the word "chamfering," the Court has said beveled or rounded. And for the "or (and)" construction, the Court has said and/or.

Q. So based on the constructions provided by the Court, what's your conclusion on -- is the element satisfied by the

Defendants' accused devices?
A. Yes. And I show here a Samsung Document PX-0867. This document is a progression through the flow of the Fin. So it starts out right after its first etch being quite square, and then as it moves through the flow, there are certain etch steps and certain oxidation steps that will round the Fin through an etching oxidation process.
Q. And is this confirmed by the -- the Defendants' own engineers?
A. Yes, sir. Dr. Dong-won Kim confirms that the Fins are rounded through an oxidation etching process. And Mr. Jeong confirms that the tops of the Fins are chamfered.
Q. And so what is your conclusion on Claim 15?
A. My conclusion on Claim 15 is that the two requirements are met. The top two corners are chamfered -- that is, bevelled or rounded -- and it is done through an oxidation and etching and/or annealing process in a hydrogen atmosphere. And just keep in mind with regards to my first comments, it's still a wall-shape Fin after this exercise.
Q. And what are the next claims that you analyzed?
A. I next analyze Claim 16. This is another one of these dependent claims that references earlier claims. This one references Claim 2. And remember for the jury, Claim 2 turns around and references Claim 1.
And this is another one of these height specs

between 10 and a thousand nanometers. I'm going to remind the jury of where that one is.

This is the one from the bottom here to the top there. And it's 10 to a thousand nanometers, and it turns out, the reasons familiar to the jury, is we've seen that before in Claim 3.

Q. And is this size limitation met in the accused devices?

A. Yes. For the same reasons it was met in Claim 3, it's met here. So we can check this one off and mark it infringed.

Q. And what about the next claim, 17?

A. Claim 17, the jury is going to get on the pattern here. Claim 17 is just like Claim 16. And this time -- you've seen this one before. This one is from the top here to there. And you'll recognize the numbers as being between 5 nanometers and 300 nanometers, and that's the same height you saw in Claim 4.

Q. And so what's your conclusion on Claim 17?

A. This one infringes for the same reasons Claim 4 infringes, so we'll check it off.

Q. Dr. Kuhn, can you summarize your conclusions so far with respect to the claims that you've looked at?

A. So far, we've demonstrated that Claim 1 is infringed, and we've demonstrated that all of the dependent claims that hook into Claim 1 are infringed, as well.

Q. And so now what's the final claim you'll be looking at?
A. We'll look at Claim 13 now.
Q. And is Claim 13 an independent claim?
A. Claim 13 is an independent claim, that's correct, sir.
Q. And how does it compare to Claim 1?
A. Well the good news for the jury is that the entire top part of Claim 13 is identical to Claim 1. The only difference is in this bottom wherein clause. You'll recall in Claim 1 we had some thickness specifications. In this claim, we're going to be talking about the resistance of the Fin active region by enlarging the width within the oxidation layer.
And give me a second to pull the model apart to show the jury what we're looking at.
So what we're going to be talking about here is the claim is claiming that the resistance is improved by the fact this widens at the bottom. And notice the widening at the bottom is occurring within the second oxidation region so the part the Plaintiff is talking about is widening as it comes down through here.
Q. Now, with respect to the common elements between Claim 1 and Claim 13, you earlier showed your analysis for those in Claim 1. So what's your conclusion for those common elements in Claim 13?
A. We've already shown those common elements to be

infringed, so we can check them off.
Q. And so what's the last element that you're actually analyzing here?
A. We're analyzing a two-part element. Again, it's enlarging the width of said Fin active region within the oxidation layer as it approaches the bulk substrate, and the second part is the resistance of the active region will be reduced as a consequence of this widening.
Let me make a note again for the jury. This is another place where the decisions of the Court apply. The oxidation layer is to be interpreted as the second oxide layer.
Q. And is this enlarging feature found in the accused devices?
A. Yes, sir. And here's a picture. This one happens to be from TechInsights, but you've seen a number of pictures earlier that show the same feature. This is from 0373. And you can see the Fin widens as it approaches the bulk substrate.
Q. And does the widening reduce the Fin resistance in the accused devices?
A. Yes. And I did some modeling on this. And the horizontal axis is resistance -- sorry, the vertical axis is resistance, the horizontal axis is Fin width. And what I'm doing is I'm computing the resistance as a function of the

bottom Fin width. And you can see the resistance is decreasing. At the bottom, Fin width increases. And the Samsung Fin lies about here.

Q. So what is your conclusion with respect to Claim 13 then?

A. That both parts of that claim are -- that both parts of the last wherein clause are infringed. And as a consequence of the top being infringed from Claim 1 and the bottom infringed what I just showed you, Claim 13 is infringed.

Q. So would you summarize your infringement analysis and your conclusions thus far?

A. Yes. I've shown Claim 1 is infringed, the dependent claims that depend on Claim 1, 2 through 6, 11 and 12, and 15 through 17 are infringed, and I've shown Claim 13 is infringed.

Q. Now, Dr. Kuhn, we've just gone through the infringement analysis. What's the next topic you'd like to discuss?

A. So next I want to talk a little bit about willful infringement. I am going to move the model back so I can speak more directly to the jury.

THE COURT: Dr. Kuhn, as we go forward, would you try to slow down just a little bit.

THE WITNESS: Yes, sir. Absolutely, sir.

THE COURT: You're speaking a little fast, and I want to make sure the jury follows what you say.

THE WITNESS: Thank you, sir.
THE COURT: Let's continue, counsel.
MR. CHOUNG: Yes, Your Honor.
Q. (By Mr. Choung) Dr. Kuhn, I think you mentioned this earlier, is intent, knowledge, or copying required to prove infringement?
A. No, intent, knowledge, or copying is not required.
Q. So you've shown infringement independent of those?
A. Yes, sir.
Q. All right. But is there evidence of copying in addition to the infringement?
A. Yes, there is evidence of that.
Q. And what is that evidence?
A. Well, there's a series of presentations that Professor Lee gave to Samsung, and you've heard some discussion on that already. There's two groups of presentations, a 2006 and a 2012 group. And I'm going to be showing some slides, particularly from the 2006 group, that show key features of Professor Lee's design that have been transferred to Samsung through these presentations.
Q. So what's an example in PX-273 of the features that were taught to Samsung?
A. This particular slide shows over here on the right-hand side the same body type FinFET that we've been discussing today. And it walks through some of the benefits of this

design. And then it compares over here, this design to the SOI FinFET, which we've also talked about today. And so this slide is somewhat conveying the whole idea of the body-tied FinFET in the presentation.

Q. And have we seen this feature in both the claims and the accused devices?

A. Yes, we've seen the body-tied FinFET, yes, sir.

Q. Now, did Professor Lee also teach the importance of any other features to Samsung?

A. Yes, he did. Recall that we've talked about the idea of being a wall-shaped Fin. In this particular 2006 presentation, you can see over here an example of a wall-shape Fin that's relatively short, and then Professor Lee's advanced research on this Fin showing the progression to an ever taller narrower Fin was quite flared at the bottom.

Q. And this is a feature that we find in both the claims and the accused devices?

A. Yes, sir.

Q. Did Professor Lee teach the importance of any other features?

A. Yes, sir. Recall a few minutes ago, we talked about the triangular-shaped source/drain region and the contact landing on that region, and we talked a little bit about crystal growth with epitaxy, kind of like growing salt

crystals.

Professor Lee showed this. This is a slide that on this side, he shows the feature without the epitaxy, and on this side he shows the feature with the epitaxy. It's a pasted Photoshop kind of image.

And then over here on the right we see two sets of curves, dark ones and light ones. And the dark ones are taller than the light ones which shows significant improvement.

So he's shown the importance of selective epitaxy and the source/drain region enlargement or the contact resistance that we just saw a few minutes ago in the claims.

Q. And that feature is found in the accused devices?

A. Yes, sir.

Q. Any other features that Professor Lee demonstrated?

A. Yes, sir. Recall Claims 11 and 12 where I moved the epi region above and below the edge of the second oxidation layer, and I said Claim 11 was above and Claim 12 was below.

Well, this slide actually has the data by which Professor Lee determined that that claim would be true. And he has a graph here that shows the depth and various electrical properties showing Claim 12, which is the below claim, has the better performance, and Claim 11, which is the above claim, has the better short channel effects. And that's written in his patent specifications and captured in

the claims.
Q. And you found these in the accused devices, as well?
A. Yes, sir.
Q. And any other feature that was taught in these presentations to Samsung?
A. Yes, sir. We've talked a little bit about the chamfering or corner rounding. Professor Lee has shown the chamfering process here in the presentations. And that's also reflected in some of the Samsung design documents, specifically 0853.
And the original presentation, I'm sorry, was 0273.
Q. Now, the figure here on the left from -- that's from PX-273, that precise figure is not in the -- in the patent, is it?
A. No, only the description of the figure in Claim 15. The description in Claim 15 that would lead you to this figure.
Q. Okay. And that's Claim 15, and that's the chamfering feature?
A. Yes, sir.
Q. And the Court defined that to mean beveled or rounding?
A. Yes, sir.
Q. Okay. Thank you.
So based on the evidence that you've seen, where does the Samsung design come from?
A. All the evidence I've seen suggests it came from

Professor Lee.
Q. Now, what's the next topic that you'd like to analyze?
A. I'd like to talk about benefits of the invention.
Q. And what was your conclusions -- could you give us a summary of your conclusions on the benefits?
A. At a very high level, the benefit gives improved performance, improved power, and cost savings.
Q. What does improved performance mean in sort of practical real-life terms?
A. Improved performance in real life means if I have a phone or iPad, if I have improved performance I can either have things run faster or I can run a lot more things at the same time.
Q. And what does improved power mean in sort of real-world practice?
A. Improved power means -- if I have, for example, I'm taking a tablet or a laptop on an airplane, improved power means that I either can have the battery last all across the United States, something I just learned recently, or you can have many more things running for a longer length of time.
Q. Now, the benefits, what are they attributable to?
A. The power performance benefits are directly attributable to the '055 bulk FinFET transistor.
Q. And how did you quantify those benefits?
A. I started out by looking at Samsung's own performance

data, which compares 20-nanometer and 14-nanometer transistors.

I then looked at some power performance data, some benchmarking data from identically designed portions of 20 and 14 chips.

I have some external data for power comparisons at the transistor level.

And then I looked at the Defendants' internal materials, and this was for comparing 28 to 14.

Q. And what did you find for the Samsung devices?

A. I'm going to start from a high-level presentation of Samsung's, which is PX-0889. And this talks about their 14-nanometer FinFET, the breakthrough power and performance.

And it gives two numbers, it gives a 20 percent number right here and a 35 percent number right there. And in both cases, it's from 20 to 14LPE. And this is PX-0889.

Q. And is there data that confirms these improvements?

A. Yes, there. Amongst the data that was delivered to us by Samsung is a chart, and it was originally an Excel file. And I went in the file and double-checked it to make sure the computations were correct.

It's a chart of the transistor-level performance numbers for their devices, and it compares 20LPE to 14LPE. And it has all the transistor parameters in it that device people like to look at.

And they did a final summary here, and I did double-check that summary. It is correct from the numbers in their table. And if you average that, it gives a 21 percent performance improvement.

Now, what's cool about this chart is that this is transistor-level data. There's no circuits here. These are measured right off the devices. And it's raw operating data. So it's very direct to confirm these numbers.

Q. And that's for the performance improvement. What was the power consumption improvement that you found?

A. So for power consumption, I used some external data from a company called AnandTech, which is a gold standard benchmarking company. And they happen to have the operating voltage numbers for various circuits, and operating voltage is one of those things that is directly impacted by improvement and short channel effects, the improvement that's given by the '055 transistor.

And so I was able to take these numbers -- there's a little math in between, but I was able to use them to determine that there's a 36 percent average power improvement that is due solely to the transistor itself.

Q. And was there any other external data that you analyzed?

A. Yes. So far, all I've talked about is data that's either at the transistor level or directly attributable to the transistor.

Now, I'm going to go up one level. Device engineers like myself, what we love to find is a product that a designer has left identical in two different processes. It's the same design, just moved, because what we then do is we say, oh, it's an identical design in two processes, therefore, any improvement, or for that matter, any degradation, is due to the process. It's not due to the design.

And there's a couple examples of this. And I show one here. This happens to be one of the cores from the Exynos processes, and it's an A53 core. And what's plotted here is performance on one axis and power on the other. So performance is horizontal. Power is vertical. And I have two graphs, one for the 20-nanometer generation, and one for the 14. So identically designed cores, two different generations.

I can read the plot crossways which gives me the performance improvement at constant power. Or I can read the plot down, and that gives me power improvement at constant performance. And so you can see there's 16 to 20 percent performance improvement and 28 to 34 percent power improvement from a core of identical design running two different processes.

Q. Now, you mentioned this data is for the Exynos chip?

A. Yes, sir.

Q. Which Defendant is that?

A. That's Samsung.
Q. All right. And so this is the data for the transistor in the Samsung Exynos chip?
A. Yes, sir.
Q. All right. And, again, this is representative of the 14-nanometer transistor?
A. Remember the design is involved here. So the previous data is representative of all the transistors in the process. This data is -- because there's circuit design involved, would be representative of the transistor interacting with the circuit.
Q. And so far you've looked at both the internal Samsung data and this external data. Are the numbers consistent for the improvement?
A. Yes. And this is actually important. Remember these things stack on each other. The transistor feeds into the chip. The chip feeds into the product. If the number at the transistor level and the number at the chip level are the same, this is a really good sign. It means that you're just transferring the improvement up the stack.
If the number goes down, then you've lost it, and it's very rare for the number to get bigger. But if it got bigger, it meant there was some additional improvement. The fact the numbers are the same is a very strong indication of the transistor is responsible for the improvement.

Q. Now, Dr. Kuhn, why are you running the comparison against the 20-nanometer node?
A. Because the 20-nanometer node was the last bulk planar node, and the 14-nanometer node is the first FinFET node. And the data was very clean from the Defendants' documentation and externally.
Q. But did you consider any other comparison?
A. Yes. As I -- you recall I mentioned earlier, the 20-nanometer node was not a successful node. So I went beyond that and looked at data from the 28-nanometer node, as well.
And keep in mind that what happened here is I first had done this comparison because the data was so good, but I'm also going back and doing this one because we do have a challenge that that was not a very successful node.
Q. All right. So for the -- this additional comparison that you ran, what was the data that you looked at?
A. I first looked at a document from Samsung, the PX-0380. And this document discusses 14LPE in comparison to 28LPP. And the summary is a 40 percent faster in performance improvement, 60 percent less power consumption, and 50 percent smaller chip scaling. And that is a two-node jump.
Q. And what about the benefits from data from GlobalFoundries?
A. GlobalFoundries has a similar set of numbers, slightly

different slide. This is from PX-0849. Here, you're looking at a 55 percent performance improvement, a 60 percent power improvement, and here they've gone from 28 to 14LPP.
Q. Now, besides these performance and power benefits, are there any other benefits to the invention?
A. Yes. There's a benefit in cost. Keep in -- keep in mind that the 20-nanometer node actually did something we don't like in Moore's Law scaling, and the 20-nanometer node was actually more expensive.
Here we see a return to traditional Moore's Law scaling with a cost benefit with a node jump. And so we have here from GlobalFoundries an estimated die cost improvement of 25 percent. This is from PX-0849. And above it is an area comparison. And I used some of my own knowledge from Intel, plus the area comparison number, to check that die cost number, and I got a rather similar number. I got 23 percent. So I agreed with their 25 percent in cost savings number.
Q. Now, is there any other evidence that supports these benefits being attributable solely to the '055 patent?
A. Yes. We have some testimony from Dr. Samavedam, who, again, is a senior engineer at GlobalFoundries, and he confirms in his testimony that the performance benefit from 28 to 14 is driven by the difference between the planar

transistor and the FinFET transistor. And he confirms that the density benefit of 28 compared to 14 is determined by the FinFET, as well. So he confirms that in his testimony.
Q. And what about Samsung's engineers, what did they confirm?
A. Dr. Kim also confirms that the shape of the Fin in the 14-nanometer process is an important contributor to the performance.
Q. And so what are your conclusions about the benefits attributable to the '055 patent?
A. My high-level conclusions are in going from 20LPE to 14LPE, which is the jump from planar to FinFET, there's at least a 20 percent performance improvement and at least a simultaneous 30 percent power improvement attributable solely to the transistor of the '055 patent.
Q. Now, Dr. Kuhn, what's the last topic that you'd like to address?
A. I'd like to talk about a topic that I've labeled here: No other options.
Q. And what is that referring to?
A. Well, this refers to an idea that the Defendants might have had an alternative available to them or another option. And there's the language "a non-infringing alternative," which would be an option that didn't infringe. And what we're going to be talking about is the lack of availability

of other non-infringing options or other non-infringing alternatives.

Q. Now, Dr. Kuhn, were there any commercially viable non-infringing alternatives in 2015?

A. No, sir.

Q. Now, what was the state of alternatives starting in the 2000s?

A. Well, if we wind back to the early 2000s and we look at the semiconductor era of that time, the world was really focused on SOI. And it was focused on SOI in two forms. Recall I told you about the improvement of strain scaling -- strain CMOS that provided an extension of Moore's Law and the improvement of High-k that provided the extension of Moore's Law. People were really looking for something that would provide an extension of the planar roadmap.

And there's an idea called fully depleted SOI, and that idea is that you buy a magic substrate and you stick it in your planar process and you get that improvement. So that idea was very exciting in the early 2000s.

The alternative idea is one you've already seen which is running a FinFET but running it on an SOI substrate. So these were very attractive ideas, and the community was going off pretty strongly that way. And Professor Lee was somewhat unique in going off in the direction of a bulk FinFET.

Q. And what information do we have that shows us what -- why the community was interested or in what the community was interested in SOI?

A. There's a group called the ITRS, the International Technology Roadmap for Semiconductors. This is actually kind of like a committee or working group that meets, puts out a report about every year. And it's formed from senior and knowledgeable representatives from all of industry and from academia.

And their report is like a roadmap of where they think the industry is going to go. It's very reputable. It's used extensively by the industry.

And we're going to look here at the ITRS for 2011. And I want to draw your attention, this is a chart in sequence with what's going to happen, with later stuff at the bottom and earlier stuff at the top.

And you can see that fully depleted SOI MOSFETs, that's my magic substrate a few minutes ago, are sitting ahead of what's called multi-gate MOSFETs. And multi-gate MOSFETs are things like SOI FinFETs or bulk FinFETs.

So in 2011, the world really thought that FDSOI, this magic substrate, was going to be the way people were going to be able to stay on the CMOS roadmap.

Q. And is this the direction that the industry was looking at?

A. Yes, very strongly.

I show on the top a document PX-2034. This document discusses GlobalFoundries, Samsung, as well as IBM. And talks about the work particularly on UTB SOIs. That's another word for FDSOI or the magic substrate.

IBM was very focused on this at this time.

I show PX-2053. This talks about ETSOI. Again, another name for FDSOI or the magic substrate.

So in 2011, people were very excited about the option of an SOI alternative.

Q. Now, that's not the state today. So what changed in -- in the interim?

A. Intel released the bulk FinFET, and they announced it in May, and I believe the product qualified earlier the following year.

This was an enormous game changer. Intel at this time had led the technology through four generations, working on the fifth. And the fact that they went to a bulk FinFET was incredibly powerful.

Notice that their press release here, which is PX-1322, they state: 22 nanometers, a New Technology Delivers an Unprecedented Combination of Performance and Power Efficiency.

And they have licensed the '055 patent.

Q. Now, I want to look at this slide, how are you familiar

with all of this?
A. I was at Intel working at Intel at this time. I was an Intel fellow at this particular time. I was working on, I believe, the 10-nanometer or 7-nanometer node. So I was deeply involved in these things.
Q. Okay. Now, you've dismantled your model so let's take a look at Professor Lee's model.
In the Intel device there's a second oxide. What is that made of?
A. In the Intel device the second oxide is made of silicon dioxide.
Q. That's the SIO2?
A. That's the SiO2.
Q. So you show here that Intel took a license to the '055 patent. What happened after that license in this announcement of Intel's bulk FinFET?
A. There was an amazing shift of the community away from SOI to bulk. Intel built 22 and 14 on bulk.
As we've shown, Samsung built 14, GlobalFoundries built 14, and we've shown both of those are infringing. Those were on bulk.
Samsung then followed with 10. And I've mentioned TSMC already, TSMC moved to bulk FinFET on 16.
Q. Now, how do you know that the Samsung's 10-nanometer device uses bulk FinFET?

A. I did a program analysis of this device. I referenced PX-0866 and PX-0424. And I went through and evaluated Claim 1 against the materials in these two documents, and Samsung 10-nanometer meets the elements of Claim 1, as well.
Q. And how do you know about the TSMC's bulk FinFET?
A. Somewhat the same thing. Here, I reference PX-1314. And this meets the elements of Claim 1 and Claim 13.
Q. And who else says that the industry embraced the bulk FinFET?
A. We can look to the testimony of Dr. Vadi, who I remind you is a principal engineering manager at Qualcomm. And he points out in 2014, Qualcomm -- all the alternatives Qualcomm were considering was bulk FinFET. And he points out, as is exactly correct, in 2014 everyone in the industry was going in the bulk FinFET direction, including multiple foundries, Intel, TSMC, and Samsung.
Q. So by 2014 and 2015, the bulk FinFET was quite established?
A. Yes, sir.
Q. But Intel announced in 2011/2012 -- was that controversial before reaching the point that the industry is now?
A. Oh, yes. It's hard to describe today now that it's been successful. But in the semiconductor industry the idea of making things that stick up in the air was just very

frightening.

For manufacturing in this business, for 50 years, people had learned the hard way that things that stick up in the air break, they get stringers on the side, they get layers that don't form correctly, they get things that hook up in places and cause -- cause yield issues.

And so having us device guys proposing to the manufacturing guys, we're going to make something that sticks up in the air 15 nanometers, they're going, no way, that's not going to work.

And so there was great resistance to this. Some of it was genuine. They are hard to make. But a lot of it was just years and years of success with planar having to move to something new. So there was much resistance.

Q. But the alternatives that were in development -- well, let's look a planar -- planar SOI. Was that actually an option?

A. No, it really wasn't. I present some testimony here from Dr. Samavedam that supports that certainly GlobalFoundries was not looking at planar SOI.

Q. And what about this SOI version of FinFET that we've talked about, is that an alternative?

A. Well, I start here with some testimony from Dr. Kim who points out that as soon as Samsung began experimenting with FinFETs, they rejected the option of SOI FinFETs.

I had a very similar experience to Dr. Kim at Intel when we went through the process of evaluation, we also rejected SOI FinFETs.

There's a number of reasons that are both economical and manufacturing related, but every company that's evaluated these things has moved to bulk FinFET first. To the best of my knowledge, there's only one SOI FinFET process running, and it's a very low volume custom boutique process that was only introduced last year.

Q. In 2017?

A. Yes, sir.

Q. All right. So that wasn't available in 2014 or 2015?

A. No, sir. No, sir.

Q. Okay. Now, you heard in the Defendants' opening mentioning about prior art patents. Are any of those viable?

A. No, sir. I've reviewed several prior art patents. I summarized some of them there. There's a block of patents from Toshiba, there's a patent from Samsung, a much earlier patent, there's a patent from LSI.

And sort of to summarize a higher level and more detailed analysis, these patents were never commercialized.

Q. All right. So they just don't work?

A. They just don't work.

Q. Now, is there also another area of alternatives that you

understand the Defendants are proposing?
A. Yes. There's -- every year in this business, there are many clever new ideas that are proposed in the research community. And all of them look really very good on paper. But what happens is they need to go through a long process of evaluation, and many of them are not successful.
And I present here one of these. Dr. Subramanian has discussed this, as well. This is called a nanowire or a multi-bridge conductor device. It's actually built from a FinFET.
And it's an interesting idea, but it's theoretical research. It's many, many years from commercialization. And certainly wasn't available in the timeframe of interest, is not available today, and it's not clear it will ever be commercialized. We'll just have to wait and see.
Q. So, Dr. Kuhn, what are your conclusions for each of the non-infringing alternatives that the Defendants are proposing?
A. Here's a summary slide of the conclusions. I'm just going to run down and hit each one at a high level, and then we'll discuss a few in detail.
Bulk FinFET, those are infringing alternatives. We've not run into one that we don't think would have not infringed. Let me say that again, the bulk FinFET alternatives were most likely to have infringed.

Planar bulk, I've already discussed. There's no future for planar bulk past 20 nanometers.

Planar SOI comes in two camps. There's a PDSOI which scales just like planar bulk. That won't work. We've already talked about FTSOI, the magic substrate. It wasn't available.

There's SOI FinFETs in the not available bucket.

There's prior art. I've talked about that, that's not viable.

And there's research topics which are a large number of topics, but they tend to fall into either the not viable, not available, or both category.

Q. And so, Dr. Kuhn, would you summarize your conclusions?

A. Certainly. Overall, my conclusions are the Defendants' 14-nanometer bulk FinFET transistors infringe the '055 patent. The benefits of using the '055 patent are at least 20 percent performance, at least 30 percent simultaneous power improvement, and 25 percent cost savings.

And there were no commercially available non-infringing alternatives.

Q. Thank you, Dr. Kuhn.

MR. CHOUNG: Pass the witness, Your Honor.

THE COURT: Cross-examination by the Defendants? Proceed when you're ready, Mr. Soobert.

MR. SOOBERT: Thank you, Your Honor.

CROSS-EXAMINATION

BY MR. SOOBERT:

Q. Good afternoon, Dr. Kuhn.

A. Good afternoon, sir.

Q. Good to see you. It's been a few months since I saw you at your deposition.

A. It has been.

Q. How you been?

A. I've been good. You, too?

Q. All right. Let's talk about the question of what Professor Lee invented. You understand that the claims define the invention, right?

A. Yes, sir.

Q. Okay. And so whatever Professor Lee invented are defined in those claims, right?

A. Yes, sir.

Q. Okay. Now, Professor Lee didn't invent the FinFET, did he?

A. No, sir.

Q. And Professor Lee didn't invent the bulk FinFET, did he?

A. I disagree with that.

Q. Okay.

MR. SOOBERT: Let's go to DX-277, please.

THE WITNESS: Is that -- oh.

THE COURT: Do we have more notebooks to pass out?

Let's do that.

MR. SHEASBY: May I approach?

MR. KENNERLY: May I approach, Your Honor?

THE COURT: Yes, you may.

MR. KENNERLY: Thank you.

Q. (By Mr. Soobert) Dr. Kuhn, I'm not going to ask you specifically about this document in your notebook. I'd just like to ask a couple of questions.

A. Yes, sir.

Q. Okay. This is the Inaba patent reference that you've analyzed in this case, isn't it?

A. Yes, sir.

Q. Okay. This is a Toshiba patent?

A. Yes, sir.

Q. This was filed in September of 2001?

A. Yes, sir.

Q. All right. And that's before the '055 patent was filed in the United States?

A. Yes, sir.

Q. And that's before the Korean patent application from Professor Lee was filed in Korea?

A. I have -- I'm sorry, I have forgotten the exact filing date of the Korean application.

MR. SOOBERT: So let's zoom out for a moment, please.

Q. (By Mr. Soobert) And look at the figure at the bottom.
A. Yes, sir.
Q. Okay. And -- and just so we're clear, a bulk FinFET simply means that the Fin is tied to the bulk substrate; isn't that right?
A. Yes, sir.
Q. Okay. And this Inaba patent shows that feature, a bulk FinFET tied to the silicon substrate, doesn't it?
A. Yes, sir.
Q. Okay. And now, let's turn to your notebook. We don't need to publish this, but I want to refresh your recollection so you have a clear memory.
Turn to Page 59 in the tab in your notebook in front of you, your rebuttal report, so...
A. I have my rebuttal report, sir.
Q. And I'd like to direct your attention, Dr. Kuhn, to Page 59.
A. Yes, sir.
Q. Okay. And 59 lists a number of prior art patents that predate the filing of the '055 patent; isn't that right?
A. Yes, sir.
Q. Okay. And those are patents that you've analyzed in this case, right?
A. Yes, sir.
Q. Okay. And that chart that's on that page is a summary

to some extent of the features in those patents; isn't that right?
A. Yes, sir.
Q. And you have a column there that identifies a number of -- of those references as being bulk FinFET devices, don't you?
A. Yes, sir.
Q. Okay. There's about five there -- at least five, right?
A. Slight correction. The column type in that chart simply refers to the substrate, not to whether it's a FinFET or not.
Q. Okay. But you would agree that the bulk FinFET is the Fin being tied to the substrate, right?
A. Yes, sir.
Q. Okay. And we just saw the Inaba reference certainly has that feature.
A. Yes, sir.
Q. And you're familiar with the Hieda reference which you've analyzed extensively for this case. That likewise shows a bulk FinFET, doesn't it?
A. Yes, sir.
Q. Okay. And so with those disclosures, amongst others in your report, I mean, there's no question, is there, that Professor Lee didn't invent the concept of tying a Fin to the bulk substrate; isn't that right?

A. That's fair, sir.
Q. Okay. So to say that in a short version, Professor Lee didn't invent the bulk FinFET generally; isn't that correct?
A. Yes, sir.
Q. Okay. Now, Dr. Kuhn, you -- you said you retired from industry about -- about four years ago, 2014?
A. Yes, sir.
Q. So you haven't been working in industry in that time period; is that correct?
A. No, sir.
Q. Okay. You've been a professor in that period, as well?
A. Yes. A part-time professor, yes, sir.
Q. But you certainly left Intel in 2014, right?
A. May, sir.
Q. Okay. And Intel's a competitor of Samsung, right?
A. Yes, sir.
Q. And Intel's arguably one of the largest semiconductor manufacturers in the world, right?
A. I think it's No. 2 now, which is sad.
Q. Samsung is not No. 1, are they?
A. I think they are.
Q. Oh. And Samsung makes a lot of semiconductor devices, not just FinFETs; isn't that right?
A. I've actually not looked at that in a long time, so I can't say.

Q. But they make lots of chips. You know that, right?
A. They make lots of chips.
Q. Right. Not all -- not all of those chips have FinFETs, right?
A. I don't know, sir.
Q. Let's talk about what you've been hired to do here. So you've been retained by the Plaintiff to help demonstrate infringement; isn't that correct?
A. No, sir, I disagree with that.
Q. Tell me what you've been hired to do with respect to infringement.
A. Well, I was hired to review all the data, and there has been an extensive amount of data, as you're well aware, and to use my knowledge and my experience, particularly the Intel experience, to look through all that data and to compare it, the claims and the various structures in the claims, the claims, the elements, and the limitations to pair it to that mass of data, and to determine whether I felt it infringed.
Q. And you were retained by the Plaintiff?
A. Yes, sir.
Q. And it's the Plaintiff's burden to prove infringement?
A. Yes, sir.
Q. And the Plaintiff's offering your opinion in support of its claim that there's infringement here, right?

A. Yes, sir.
Q. Okay. Let's talk about infringement. You understand that each and every element of a claim needs to be found in the accused product. You understand that, right?
A. Yes, sir.
Q. Okay. And you understand conversely that if one element is entirely missing from the device, there's no infringement, right?
A. Yes, sir.
Q. And in doing that analysis and in forming your opinions in this case, you understand that you need to perform the analysis on the actual accused product. You understand that, right?
A. No, I disagree with that.
Q. Well, you understand that the analysis for infringement is a comparison of the claims to the accused product. You agree with that?
A. Yes.
Q. Right. So it's the comparison of the claims to the products?
A. I agree with that.
Q. Right. So it's not a comparison of the claims to specifications, for example, to demonstrate infringement, is it?
A. Keep in mind it's an atomistic-level product. You can't

just open it up and look at it.
Q. But as a general premise, you agree that you need to apply the claims to the product, you agree?
A. Yes, recognizing again these things count in atoms across them. It's not something you can break open and measure with, you know, something.
Q. Understood.
The specification is not the product, it's the requirements for the product, isn't it?
A. True. But it forms part of the data, sir.
Q. Okay. So it's analogous to if we have a patent on a table, you need to compare the patent to the accused table, not to the instructions for making that table or putting it together, you agree with that?
A. I'm struggling a little bit with that.
Q. Well, you have a patent on a table, and you have a table that's accused of infringement. You follow?
A. Yes, sir.
Q. Okay. And you need to take the claims from that patent and apply it to the table, correct?
A. Yes.
Q. Okay.
A. Yes, sir.
Q. Okay. So you don't take the claims of that patent and apply it to the instructions for putting -- or the table

together or otherwise assembling it?
A. Well --
Q. Do you?
A. Oh, I'm sorry, didn't mean to talk over you.
So my struggle here is at this level of scale, the specifications that the Defendants provide are a core part of the evidence as to what they're trying to do. And in the cases where I use the spec, I also went and looked at things like TEMs, where it's probably the closest thing to physical evidence that exists in atomistic world.
Q. And that's precisely the problem we have here is that the specifications set a target, but to actually figure out if there's infringement, you need to look at the device itself with the TEMs, don't you?
A. In general, yes.
MR. SOOBERT: Let's take a look at Slide 2, please, Mr. Dahm.
Q. (By Mr. Soobert) Now, Dr. Kuhn, you recognize this claim, don't you?
A. Yes, sir.
Q. All right. We've analyzed this for some time now?
A. Yes, sir.
Q. You spent hundreds of hours, actually, on this case already; is that right?
A. Yes, sir.

Q. Okay. And you see there, there's a term highlighted in the second element of this claim, highlighted is "wall-shape," do you see that?
A. Yes, sir.
Q. All right. So this -- this element right here requires a Fin active region, which is a wall-shape single crystalline silicon on a surface of the bulk silicon substrate and connected to that bulk silicon substrate. You see that?
A. Yes, sir.
Q. Okay. So this requires essentially the Fin active region in the device to be a wall-shape, we all agree with that, right?
A. Yes, sir.
Q. Okay. And that's a term that Professor Lee testified that he put into the patent. You were here for his testimony, right?
A. Yes, I was, sir.
Q. Okay. And he used that very specific term, "wall-shape," didn't he?
A. That's the term in the patent, sir.
Q. Yeah. And he didn't, for example, use the term "Omega shape," did he?
A. No, sir.
Q. He didn't use the term "parabola shape," did he?

A. No, sir.
Q. He didn't use the term "parabolic shape," did he?
A. No, sir.
Q. He didn't use the term "triangular shape," did he?
A. No, sir.
MR. SOOBERT: Let's look at Slide 3, please.
Q. (By Mr. Soobert) Now, what what's shown here, Dr. Kuhn?
A. It's the '055 patent, but it's really blurry.
Q. Agreed.
MR. SOOBERT: Let's -- let's blow it up, please.
Can we take -- take a look at the date of when it was filed?
Q. (By Mr. Soobert) Okay. So this is a little better. It's the -- let me start again.
The patent was filed on February 4, 2003, correct?
A. Yes, sir.
Q. Okay. And this patent doesn't refer back to the Korean application, does it?
A. I don't believe it does, sir.
Q. Right. And, in fact, there's no foreign priority claim to the Korean patent application, correct?
A. I don't believe so, sir.
Q. And the -- the named inventor there is Jong-Ho Lee, you see that?
A. Yes, sir.

Q. Okay. And it has the '055 patent at the top, right?
A. Yes, sir.
Q. It's the patent that's subject to this lawsuit.
Now, if we focus again back on what's required for the shape of the Fin active region, let's look at the -- let's look at the abstract.
And you see there that the abstract says essentially -- and I'm paraphrasing -- that it needs to be formed with the shape of a wall along the channel length direction. Do you see that?
A. Yes, sir.
Q. So it explicitly says with the shape of a wall, right?
A. Yes, sir.
Q. Okay.
MR. SOOBERT: Next slide.
Q. (By Mr. Soobert) Background of the invention, same thing, uses the phraseology "with the shape of a wall," right?
A. Yes, sir.
MR. SOOBERT: Next slide.
Q. (By Mr. Soobert) And so now if we go to the patent and we look at what corresponds to that terminology, you see there in Figure 3b Fin active region, correct?
A. Yes, sir.
Q. And that's a wall-shape Fin active region, according to

the patent, isn't it?
A. It is, sir. It's -- you don't see the whole three-dimensional part if that's --
MR. CHOUNG: Your Honor, objection. Counsel is trying to compare the claims to the specification.
THE COURT: Speak up, Mr. Choung.
MR. CHOUNG: Counsel is trying to claim -- compare the specification and the figures to the claims.
THE COURT: I don't -- is -- is that a legal objection? What's the basis of your objection? You don't like what he's saying?
MR. CHOUNG: No, Your Honor.
THE COURT: Mr. Sheasby, this is his witness, you need to keep a seat, sir.
MR. CHOUNG: No, Your Honor. This has already been covered by a motion in limine.
MR. SOOBERT: Disagree, Your Honor. This is -- I'm just laying a foundation what the patent talks about with respect to wall-shape and what's shown.
THE COURT: All right. What -- what motion in limine are you asserting, Mr. Choung?
MR. CHOUNG: I believe it's No. 8 in the order, Your Honor. I'm sorry, Your Honor, No. 6.
THE COURT: What's your response, Mr. Soobert?
MR. SOOBERT: I haven't made any comparison, Your

Honor, between this and the accused products, which I believe is related to that MIL.

What I'm doing here is looking at the terminology in the claim and seeing how it's depicted in the figure to understand how that -- how Professor Lee used that term in the patent.

THE COURT: Well, pursuant to the Court's prior order in limine, a comparison between the accused products and the preferred embodiments is prohibited.

I'm going to allow the question, but if this line continues and crosses that line, then I'll have something to say about it.

MR. SOOBERT: Understood, Your Honor.

THE COURT: All right. At this point the objection is overruled.

MR. CHOUNG: Thank you, Your Honor.

Q. (By Mr. Soobert) So in terms of how the "wall-shape" term is used in the specification, this is an example of it, isn't it?

A. And I'm not quite sure if you mean -- my concern here is this shows a cross section, it doesn't show the entire length of the wall.

Q. The Fin runs through that cross section, doesn't it?

A. Yes, it does, sir.

Q. Okay. And your understanding wall-shape is it runs

through there in a rectilinear manner, right?
A. Yes, sir.
MR. SOOBERT: Let's take a look at the next slide, please.
Q. (By Mr. Soobert) And this is a similar depiction, just another cross-section view of the same figure we're looking at, correct?
A. Yes, it's Figure 7, I believe.
MR. SOOBERT: Next slide.
Q. (By Mr. Soobert) And similar with this one, it shows a cross-section of the Fin, as well, correct?
A. Actually, I may have made an error. Are we also going to be talking about the gate oxide because the thickness just changed between these two slides?
Q. I'm focused on the Fin active region.
A. Just on the wall?
Q. Uh-huh.
A. The cross-sections look similar, sir.
Q. And they run vertically into the page?
A. Thank you, sir.
Q. Yeah.
A. Yes.
THE COURT: Mr. Soobert, non-verbal responses aren't picked up in the record. You just said uh-huh, so try to correct that.

MR. SOOBERT: I'm -- I'm sorry, Your Honor. I'll be on the lookout.

THE COURT: Usually it's the witnesses that do that.

MR. SOOBERT: Fair enough.

THE COURT: Let's continue.

MR. SOOBERT: Thank you, Your Honor. Let's go to the next slide, please.

Q. (By Mr. Soobert) Now, this shows Claim 1 again with some highlights on it, doesn't it?

A. Yes, sir.

Q. And we -- we looked at the Fin active region which is a wall-shape and highlighted in orange just now, right?

A. Yes, sir.

Q. Okay. And there are additional elements that come after that, including the second oxide layer, correct?

A. Yes, sir.

Q. And the gate oxide layer, correct?

A. Yes, sir.

Q. And that gate oxide layer specified as -- let -- let me begin again.

And that element is specifying a gate oxide layer which is formed on both side-walls of the Fin active region protruded from said second oxide layer. You see that?

A. Yes, sir.

Q. And that's a requirement of the claim, correct?
A. Yes, sir.
Q. The next element is a first oxide layer, which is formed on the upper surface of the Fin -- said Fin active region with a thickness greater or equal to that of the gate oxide. You see that?
A. Yes, sir.
Q. And that's a requirement of the claim, as well?
A. Yes, sir.
Q. And then in green, we've highlighted a gate which is formed on said first and second oxide layer. You see that?
A. Yes, sir.
Q. That's a requirement of the claim, right?
A. Yes, sir.
Q. You have to meet each and every one of those elements to prove infringement, right?
A. Yes, sir.
MR. SOOBERT: Next slide.
Q. (By Mr. Soobert) And just to understand what's happening here with respect to how these are used in the specification, we see Figure 7, don't we?
A. Yes, sir.
Q. And it's been color-coded to match the claims so we can understand what the claim means at least with respect to what's shown in this figure in the specification. You

understand that?
A. Yes. I'm a little confused because I thought we have to compare this to a product.
Q. Okay.
A. Per your previous comment.
Q. Understood. I'm laying a foundation for how these terms are used with respect to the figure. You understand that?
MR. CHOUNG: Objection, Your Honor. This is going into redefining the claims and the meaning based on the figures.
THE COURT: Overruled.
And, Dr. Kuhn, it's not your place to ask counsel if he's asking the proper questions or not. That's why the lawyers are here for the Plaintiff. You either need to respond or not respond.
THE WITNESS: I'm sorry, sir.
THE COURT: Let's continue, counsel.
MR. SOOBERT: Thank you, Your Honor.
Q. (By Mr. Soobert) And so we see in the color-coded version of Figure 7 there's a Fin active region in orange. You see that?
A. Yes, sir.
Q. And then you see the second oxide layer on either side of part of that Fin active region that's No. 10. You see that's gray?

A. Yes, sir.
Q. And then wrapping around the Fin active region at the sides and the top is a gate oxide layer 12 and a first oxide layer 6. You see that?
A. Yes, sir.
Q. So we have a structure there where we have the Fin active region in orange with that first oxide layer 6 formed on that upper surface of the Fin. You see that?
A. Repeat that again. My mind drifted for a second.
Q. So we have a structure in which there is an orange Fin with the blue first oxide layer at the top formed on the upper surface of the Fin.
A. Yes, sir.
Q. Okay. And then when we pull this device, we put a gate, which is green 16, on top of that first oxide layer 6. You see that?
A. Yes, sir.
Q. Okay. And that corresponds to the language in the claim, a gate which is formed on said first and second oxide layer. You see that?
A. Yes, sir.
Q. Okay. So this figure is showing a gate that's on the first oxide. Let me withdraw that.
So this figure is showing a gate which is formed on the first oxide layer which, in turn, is formed on the upper

surface of the Fin, correct?
A. Yes, sir.
Q. And that gate is also formed on the second oxide layer that's gray. You see that?
A. Yes, sir.
Q. All right.
          THE COURT: Counsel, approach the bench, please.
          (Bench conference.)
          THE COURT: Mr. Soobert, I am getting somewhat concerned that beyond laying a foundation, we're getting into comparison -- comparing the claims to an embodiment.
          MR. SOOBERT: Uh-huh.
          THE COURT: The claim language that you're showing the jury is perfectly fine, but the figures representing embodiments from the patent in a side-by-side comparison, I believe, we're getting past laying a foundation.
          MR. SOOBERT: Uh-huh.
          THE COURT: I have no problem with you taking the Plaintiff's model that they used or the photographs of the transistors that were used, but the drawings for the embodiments within the patent, I think, is improper beyond laying a foundation. I think you've probably laid your foundation.
          MR. SOOBERT: And I have, Your Honor.
          THE COURT: Okay. Then let's -- let's proceed

without the side-by-side of the figures and the claims.
MR. SOOBERT: Understood. And I'm planning to do that.
THE COURT: Okay. Let's proceed.
MR. SOOBERT: Thank you.
(Bench conference concluded.)
THE COURT: Let's continue.
MR. SOOBERT: Next slide.
Q. (By Mr. Soobert) Dr. Kuhn, you recognize this figure as one of the defense exhibits, DX-430, right?
A. I recognize the figure, yes, sir.
Q. And this is a TEM. It's a microscopic image of the accused device, correct?
A. Of one of the accused devices, correct.
Q. And here, you -- you see that we have a Fin that's protruding up from the bottom of the screen. You see that?
A. Yes, sir.
Q. Okay. And then above that is a lighter-colored layer that wraps all the way around that Fin, which is a silicon dioxide layer, you agree with that, right?
A. Yes, sir.
Q. Okay. And then on top of that silicon dioxide layer, there is a Hafnium oxide layer that's a darker ring that's around that, it's the next part of the layer, you see that?

A. Yes, sir.
Q. Okay. Did I describe that correctly?
A. Yes, sir.
Q. Okay. And then the gate goes on top of that material towards the top of the picture, correct?
A. The gate wraps all the way around.
Q. Okay. Thank you.
So I want to ask you a little bit about this Hafnium oxide layer we were talking about.
A. Yes, sir.
Q. Hafnium oxide is a High-k dielectric, right?
A. Yes, sir.
Q. And it has a higher dielectric constant than the silicon dioxide layer; isn't that right?
A. Yes, sir.
Q. Okay. And not to get too technical, but tell us what the dielectric constant means?
A. It's kind of a relative thickness number. Kind of keeping it so the jury is clear, too.
If I have a film with a high dielectric constant, the film acts electrically like it's thicker.
Q. Okay. So Hafnium oxide has a high dielectric constant, right?
A. Yes, it does, sir.
Q. And so Hafnium oxide is also known as High-k, right?

A. Yes, sir.
Q. So if I refer to High-k, you know I'm talking about Hafnium oxide, right?
A. No, sir.
Q. Okay. I'll stick with Hafnium oxide.
A. Yes, sir.
Q. Now, the Defendants' products, these two layers, Hafnium oxide, which is formed on the silicon dioxide layer, are formed by different processes, aren't they?
A. Yes, sir.
Q. Silicon dioxide is formed by a process of oxidation; is that correct?
A. Sir, there are two devices in the process. You're showing the I/O device for which the oxide layer is formed through an oxidation process, a conventional oxidation process.
The logic device uses a different ChemiSorb oxidation process that's rather dramatically different.
Q. Let's focus on this device, how about that?
A. I'm fine with that, recognizing that we keep in mind there are two of these.
Q. So with that clarification, you agree that the lighter-colored silicon dioxide layer is formed through a process of oxidation, right?
A. Yes, sir.

Q. Okay. And in a different step in the process, we have a Hafnium oxide layer, the darker ring, formed on top of the silicon dioxide, correct?
A. Yes, sir.
Q. Okay. And those are formed by separate processes, correct?
A. Yes, sir.
Q. And they're actually formed on different machines in the process; isn't that right?
A. For this device, sir.
Q. Okay. And when I say machine, I'm loosely speaking as a semiconductor tool, you understand that, right?
A. Yes, sir.
Q. Okay. So in the process of fabricating a semiconductor device, these devices are transferred from tool to tool as they're being fabricated; is that correct?
A. For the I/O device, the legacy I/O device, sir.
Q. Okay. The one we're talking about here?
A. The device on the page, sir.
Q. Okay. So you agree that those two layers are formed on different machines or tools, correct?
A. Yes, sir.
Q. Okay. They're formed at different times in the process, correct?
A. Yes, sir.

Q. The Hafnium oxide layer in this process is formed actually by what's known as atomic layer deposition. You agree?
A. That's my understanding, sir.
Q. Right. And we'll just talk that ALD, correct?
A. Yes, sir.
Q. Okay. Now, we've heard from Professor Lee that he didn't use Hafnium oxide by that name in his patent. You agree with that, right?
A. That's my understanding, sir.
Q. Okay. So, in fact, I believe he testified that he intended to create a FinFET without using a High-k material. You agree with that?
A. I don't recall that, sir.
Q. Okay. But you were here in the courtroom when he testified, correct?
A. Yes, I was, sir.
Q. Okay. And you haven't seen anything in his patent that suggests that he intended to include -- let me rephrase that.
You haven't seen the words "Hafnium oxide" in the patent, have you?
A. No, sir.
Q. They, in fact, don't appear in there, do they?
A. No, sir, they don't appear -- yes, sir, they don't

appear. They don't appear.
Q. And so we're clear, the patent also doesn't refer to High-k materials?
A. That's correct, sir.
Q. Okay. So I want to go back to about the 2003 time frame?
A. Yes, sir.
Q. When this invention in the '055 patent was filed in the United States Patent Office.
A. Yes, sir.
Q. Okay. And at that time, the industry was wrestling with how to make these devices smaller and scale them down, would you agree with that?
A. If I look at the industry at this time, the industry was almost in the golden age of scaling. I mean, this was about the 130 nanometer generation. And, man, silicon was cranking. Things were actually going really well. Research was looking at those things but not yet the industry.
Q. Okay. So research was looking at transistor scaling at that time, fair?
A. Extreme transistor scaling, yes, sir.
Q. Okay. And folks that you worked with at Intel, such as Robert Chao, were looking at scaling and transistors, weren't they?
A. Again, research, yes.

Q. They were looking at various options to consider to reduce the gate size so there wouldn't be leakage, right?
A. Yes, sir.
Q. Okay. That's what we're talking about in terms of scaling, right?
A. Yes, sir.
Q. Okay. We're trying to eliminate that leakage when we make this gate so small that we don't have a problem, right?
A. Yes, sir.
Q. Okay. One of the ways that was being kicked around is let's introduce a High-k material so we can make the gate smaller; isn't that right?
A. It's two steps, but yes, sir.
Q. And, again, Professor Lee wasn't focused on that and didn't describe the High-k material in his '055 patent, did he?
A. I don't know about his focus. But he certainly did not describe High-k.
Q. Yeah. And this was actually a very significant problem, you agree, in the industry?
A. Scaling? Yes, sir. Scaling was a significant problem.
Q. And you're a science fiction fan, aren't you?
A. Yes, sir.
Q. Okay. And didn't you liken this problem to being on the bridge of the Starship Enterprise at one point?

A. Yes, I did.
Q. Okay.
A. I described working at a semiconductor facility as being -- like being on the bridge of the Starship Enterprise, that's correct.
Q. Okay. And you actually looked at these things as if -- at some point, the solution would almost be unheard of to folks in that present day; is that right?
A. Oh, absolutely. When we started each generation, we believed that the design rules that were released would be impossible. And by the end of the generation, they were easy.
Q. And that's when we fast forwarded from 2003 to 2007, a lot of work had been done, but then Hafnium oxide entered into devices, right?
A. That's correct, sir.
Q. Okay. And one of the ways that problem -- let me rephrase.
One of the ways that problem was solved was the introduction to -- of Hafnium oxide and then a metal gate, and that combination allowed the transistor to be -- transistor to be scaled further, right?
A. Yes, sir, absolutely, sir.
Q. Okay. And that helped address the leakage problem that we touched on, right?

A. Metal -- metal gate prevents polysilicon depletion.
Q. The use of Hafnium oxide helped with the leakage problem, right?
A. Yes, sir.
Q. Okay. So it was Hafnium oxide or the High-k material that helped you get past the leakage problem, not the metal gate, right?
A. The metal gate is simply to reduce polysilicon depletion and to keep the VTs correct in the device.
Q. So in this high -- timeline that I'm just talking about, we hit 2007, and this Hafnium oxide high gate material enters into the 45-nanometer devices, right?
A. That's right. Intel released 45-nanometer with High-k metal gate in 2007.
Q. Okay.
MR. SOOBERT: Jeff, can we have the Gordon Moore timeline of scaling from the Plaintiff's opening? And I apologize, Mr. Dahm.
Q. (By Mr. Soobert) While that's being pulled up, Dr. Kuhn, I believe you testified Gordon Moore, he's a co-founder of -- of Intel?
A. Intel.
Q. Yes?
A. Yes.
Q. And in terms of the elite folks that are Intel fellows,

where does he stack up in the process?
A. Gordon Moore started the place. I mean, he's very senior, very respected.
Q. So when he says something, people listen?
A. Oh, yes.
Q. He says something, people take notice?
A. Yes, sir.
Q. So if he said in 2007 this move to High-k Hafnium oxide was groundbreaking and the biggest development in transistor technology in the past 60 years, people would have known about that, right?
A. Yes, sir.
Q. You yourself knew about that?
A. Yes, sir.
Q. Okay. And, in fact, you agree that it was a significant development, right?
A. Yes, sir.
Q. And at that point in time, before Intel introduced its version of 45-nanometer device with Hafnium oxide, the industry at that point was already taking notice and working on the problem; isn't that right?
A. Yes. My memory is not totally clear there, but my memory is in those years before, everybody was working very, very hard on it, and they mostly were not successful. When I first joined 45-nanometer in 2005, we just looked at a

whole bunch of things that just didn't want to work.

MR. SOOBERT: Can we go to -- let's do this.

Q. (By Mr. Soobert) Dr. Kuhn, will you turn to Tab 4 in your -- in your binder, and I'm not going to put it up on the screen yet.

A. My transis -- actions on electron devices paper?

Q. Yes. I see you're familiar with that.

A. Yes, sir.

Q. You recall that paper?

A. Yes, I do, sir.

Q. You wrote it?

A. Yes, sir.

Q. And when did it come out?

A. July 2012, as I recall -- late 2012.

Q. And it's published in what journal?

A. Transactions on Electron Devices.

Q. On what -- on behalf of what organization?

A. IEEE.

Q. Right. Is that a reputable organization?

A. Yes, sir.

Q. All right. And it's an authoritative source for information, isn't it?

A. Yes, sir.

Q. Okay.

MR. SOOBERT: With your permission, Your Honor, can

I publish that to the jury?

THE COURT: Is there any objection?

MR. CHOUNG: This document is not pre-admitted. It's hearsay.

THE COURT: I'll overrule the objection. Go ahead, counsel.

MR. SOOBERT: Thank you, Your Honor.

Q. (By Mr. Soobert) We'll take a look at this. This is the paper we just described that you wrote. 2012 -- I believe, July 2012; is that right?

A. Yes, sir.

Q. All right. And that's you there, Kelin J. Kuhn, fellow at IEEE?

A. Yes, sir.

Q. So you're an Intel fellow also, but you're also a fellow of the IEEE?

A. I'm still a fellow of the IEEE. When I retired from Intel, I became -- oh, I don't know, a fellow emeritus, I suppose, of Intel.

Q. Okay. And is a fellow of IEEE, frankly, a big deal?

A. Yes, sir.

Q. It's a prestigious title?

A. Yes, sir.

Q. We're going to hear from Dr. Wallace. You know he is a fellow of IEEE in material science and GIG oxide layers and

the like. You understand that, right?
A. Oh, yes, sir. Dr. Wallace is -- is very well-known, sir.
MR. SOOBERT: So if we go to Page 1818, please.
Q. (By Mr. Soobert) And no offense, Dr. Kuhn, this is an incredibly technical paper, so I'm going to focus on a few parts, if that's okay.
A. Certainly, sir.
Q. Okay. So in this section of your paper, you're talking about variations on -- on the gate, and there's a statement there that basically says: Modern High-k gate dielectric stacks are actually multilayers.
A. Yes, sir.
Q. Okay. And what's a -- what's a dielectric stack?
A. It means something similar to what we see in the Samsung device. It means you may have multiple components in the layer. Sometimes you'll hear me refer to those bilayers in my report. They're referred to that way.
Q. Okay. So when you say bilayer, you -- you actually -- that's a short form for two layers, right?
A. Two layers that act as one, yes, sir.
Q. Okay. But they are two layers, right?
A. Yes, sir, there's two components.
Q. Okay. And the device we looked at, we -- we agreed that those were formed at different times, different processes,

and different machines. You agree with that?
A. In the I/O device, yes, sir.
Q. Okay. And modern devices today, as you yourself state, include those multiple layers for gate dielectrics. You agree with that?
A. Oh, yes, sir.
Q. Right. And they need to include High-k material, don't they?
A. If it's a High-k stack, yes, sir.
Q. Right. And you need a High-k stack if you're getting down to 14 nanometers, don't you?
A. That's the general consensus, sir.
Q. All right. So if I took a device -- let's say a FinFET that has a Fin active region, has a silicon dioxide layer on top of that Fin and a gate on top of that silicon dioxide layer, try to shrink it down to 14 nanometers, I'm going to have big time leakage problems, aren't I?
A. Yes, sir.
Q. Okay. In fact, it wouldn't work?
A. It would work, but I agree, it would have leakage problems.
Q. Okay. It couldn't be commercially viable, would it?
A. No, sir.
MR. SOOBERT: Your Honor, I'd like to move the admission of this exhibit, please.

THE COURT: I'm not prepared to admit it as an exhibit, counsel. You've asked to use it in a demonstrative -- a demonstrative fashion for what I assumed was an effort to impeach the witness with her own publication, and that's reflected in the record. There's no need for it to be formally admitted. And as you well know, the time for admission of exhibits has long passed during the pre-trial period. I'm not going to reopen that in the middle of the trial, so your -- your motion is denied.

MR. SOOBERT: Understood, Your Honor. Thank you.

THE COURT: Let's proceed.

MR. SOOBERT: Thank you, Your Honor.

Q. (By Mr. Soobert) Now, when you moved -- well, let me take that back.

You -- you worked on that device at Intel that got to 45 nanometers with the High-k material, didn't you?

A. Yes, sir.

Q. All right. Did you get the idea to use High-k material from the '055 patent?

A. No, sir.

MR. SOOBERT: Go to Plaintiff's Exhibit 580, please.

A. Where should I look for it?

Q. (By Mr. Soobert) It may be in your Plaintiff direct materials. You were asked about it on direct. You recall

that?
A. Yes. And I certainly recall -- is it -- is this on the screen?
Q. It is on the screen.
A. Let's work off this, and if we have a problem, I'll go locate it because I certainly recognize the reference.
THE COURT: Counsel, do you want to work off the screen, or do you want the witness to find the hard copy? This is your call, not hers.
MR. SOOBERT: Understood, Your Honor. And thank you. I'll just work from the screen here. It's the same thing that's shown on the demonstrative. If we need to dig in for it, I'll let you know.
Q. (By Mr. Soobert) So let me ask my question.
A. Sure.
Q. So this -- this was highlighted in your direct, right?
A. Yes, sir.
Q. And you made a point that this shows that High-k materials and silicon dioxide materials were being researched as a single gate oxide, right?
A. That, and there's some talk in this about putting one on top of the other.
Q. Okay. So this is a -- like exploratory research type paper considering various options, right?
A. It's what's called a review paper.

Q. Well, this isn't talking about a commercial device, is it?

A. No, it's a technical -- it's a technical review paper to the technical community, sir.

Q. Okay. And so, again, a device with High-k material, Hafnium oxide didn't come out in a commercial form until 2007; isn't that right?

A. Yes, sir.

MR. SOOBERT: Mr. Dahm, may I have Slide 11?

Q. (By Mr. Soobert) So you recognize this as the TEM of the device we were looking at a little earlier, right?

A. Yes, sir.

Q. All right. And you understand that this image was actually taken on a machine in the fabrication system, right?

A. I don't understand the question.

Q. Okay. The TEM is an electron micro -- microscopic image, right?

A. Yes, sir.

Q. All right. It's taken with a machine on the device itself, right?

A. No, sir. It's even more complicated than that.

Q. Okay. Give me a brief overview, please.

A. You take the chip, you use what's called an ion mill to cut a slice out of it that's about 10 nanometers thick, and

it's mounted by technologists who are really good at this, in a special frame. And then it's put in the tool, and then it's imaged, and then the picture is taken.
Q. I see.
So the -- the device itself is taken -- a cross section is taken, and you put it in the machine and an image is taken, correct?
A. Yes. It's two steps. You can't even just put the thing in the machine. You have to cut it into this little thin transparent thing to put it in the machine.
Q. But it's a cross section of the actual device; is that correct?
A. Oh, yes, yes, sir.
Q. All right. Now, this device has some measurements on it, you see that?
A. Yes, sir.
Q. Right. And these measurements were on the device -- let me rephrase.
These measurements were on the image that were taken on the machine of the device, correct?
A. I don't know, sir. I've only seen the TEM at this end state.
Q. But these machines were added by folks at -- the Defendants, correct? That took the picture?
A. I'm sorry, I didn't understand the question.

Q. So are these -- how about this, let me ask you, how are these -- these measured in your experience, briefly?
A. In my experience, there's two methods. The first method is the machine comes with a tool, and a human sits there with the tool and lays -- points for the measurements that they want, and the tool auto computes that.
The second manner is that tool doesn't work for some reason, and people do it by hand, or they use some more physical method to measure the image.
Q. Okay.
A. And there is -- are automated ways to do this that are used for multiple samples. They are frequently unsuccessful, and so they often bounce back to one of the two previous techniques.
This particular image looks like it might have been made by a person, or it might have been done by something automatic.
Q. Okay. But it was made off the machine, correct?
A. Remember, the machine will burn the sample. So you can't just sit there by the machine and -- and measure it. The sample will fry. It's like an old-fashioned film projector with a light bulb.
So the way this works is the technician loads the sample, takes a whole string of images, bang, bang, bang, bang, bang, bang, bang, bang. So they don't -- for example,

or they'll store the images somewhere. And then they either come back or someone else comes back and measures the images.

Q. I see.

And the samples are taken off the product that's in the machine, correct?

A. The images are taken off the product. The image -- the samples are taken off the product, and the images are taken off of the samples. And the images are placed someplace and usually analyzed.

Q. I see.

Just to be clear, the image is taken of the product using the machines, and the samples are put on before you pull it out, correct?

A. Can you rephrase?

Q. The image is taken of the device, and while the device is in the machine, the samples are put on under the first method, correct?

A. Okay. So I'm -- I'm -- I don't understand your question. Let me do a quick try again.

We take the product, we make the sample, we put the sample in the machine, we take the pictures, we file the pictures, then we go offline and analyze the pictures.

Did that answer the question?

Q. Yes. And the offline analysis of the pictures, tell me

about that in the first preferred method.
A. Like anything, the first preferred method is some robot analyzes them all by itself. The first preferred method is often not successful on these films because of the atomic nature.

The next preferred method is a human measures it, but with a tool that computes all the numbers.

The third preferred method is that a human measures it again, but the software tool that does the measurement is broken in some way and a human makes a printout and measures it off the printout.
Q. So the first preferred method is using the robot, right?
A. Yes.

MR. SOOBERT: Let's go to the next slide, please.
Q. (By Mr. Soobert) What are these black boxes around this Fin?
A. Those black boxes represent measurements that I made on this image.
Q. Okay. So you got this image from the Defendants. It already had measurements on it, and then you made your own measurements on top of it to do further analysis; is that correct?
A. That's correct.
Q. Okay.
A. Because the Defendants only had two lines, and I wanted

an entire curve.
Q. Okay. And you didn't take a new picture of the device using the machine, right?
A. No, sir, no, sir.
Q. Okay. And you used the picture that was already taken?
A. Yes, sir.
Q. Right. You didn't use the robot technique, right?
A. No, sir.
MR. SOOBERT: Go back to Slide 9, please, Mr. Dahm.
Q. (By Mr. Soobert) And to frame this from an infringement analysis standpoint, this thickness issue is relevant to these light blue limitations, you agree with that?
A. Yes, sir.
Q. Okay. And those, again, for the record are the gate oxide layer, which is formed on both side-walls of the Fin active region, and the first oxide layer, which is formed on the upper surface of that Fin active region, right?
A. Yes, sir.
Q. And that first oxide layer must have a thickness greater or equal to that of the gate oxide, do you see that?
A. Yes, sir.
Q. Okay.
MR. SOOBERT: All right. Let's go back to that TEM, please.
Slide 13, please.

Q. (By Mr. Soobert) So you see here we have the original TEM that was produced in the case. And on the right side, we have the TEM that has your measurements on it?
A. Yes, sir.
Q. Correct?
A. Yes, sir.
Q. Okay. And your measurements on the right side there are blown up at the tip of the Fin, add up to 4.74, do you see that?
A. Yes, sir.
Q. Okay. And the measurements that were actually on the TEM that were produced for this device add up to 4.33?
A. Yes, sir.
Q. Okay. And, of course, your number is higher, obviously; isn't that right?
A. The two numbers do not agree, and my number is higher, that is correct.
Q. Right. So in terms of thickness, your higher number is thicker; isn't that right?
A. Yes, it is.
Q. All right. So you took these measurements knowing that you need to prove infringement to show a thickness greater or equal to on the top, and you did that analysis, right?
A. I made these measurements, yes, sir.
Q. Right. Knowing that you had to demonstrate infringement

of a thickness at the top that is equal to or greater than the thickness on the sides, correct?
A. When I made the measurements, I had no intent in mind.
Q. Okay. Putting aside intent -- let me rephrase. Putting aside your intent, you made the measurements yourself knowing that you needed to prove infringement, correct?
A. I disagree with that.
Q. Okay. You made the measurements yourself knowing that you had been retained by the Plaintiff who has to prove infringement, correct?
A. I disagree with that, too.
Q. Okay. You made the measurements yourself, correct?
A. Yes, sir.
Q. You didn't send the image out to a third party to make the measurement that doesn't have a dog in this fight, right?
A. No, sir.
Q. All right. You didn't send it to TechInsights; is that right?
A. No, sir.
Q. You didn't ask TechInsights to measure it on their own, did you?
A. No, sir.
Q. All right. And you didn't send it to any other lab

asking them to measure it; is that right?
A. No, sir.
Q. We're talking about atomic level dimensions, aren't we?
A. Yes, sir.
Q. All right. So a .4 error, is that statistically significant?
A. It could be.
Q. What this size -- the difference between these numbers is certainly statistically significant, isn't it?
A. Yes, sir.
THE COURT: Counsel, approach the bench, please.
(Bench conference.)
THE COURT: What's the estimated length of your remaining cross, Mr. Soobert?
MR. SOOBERT: I'm hoping 30 minutes.
THE COURT: Well, we've been back two hours from lunch. I'm going to give the jury a recess, and then we'll continue.
MR. SOOBERT: Thank you, Your Honor.
MR. CHOUNG: Thank you, Your Honor.
(Bench conference concluded.)
THE COURT: Ladies and gentlemen, this cross-examination has some additional length to it, and there's probably going to be redirect after that of this witness. So we're going to take this opportunity to take a

short recess.

You may simply close and leave your notebooks there in your chairs. Follow all my instructions, including not to discuss the case among yourselves. Use this opportunity to stretch your legs, get a drink of water, and we'll be back to continue shortly.

The jury is excused for recess.

COURT SECURITY OFFICER: Rise for the jury.

(Jury out.)

THE COURT: The Court stands in recess.

(Recess.)

COURT SECURITY OFFICER: All rise.

THE COURT: Be seated, please.

Are you prepared to continue with your cross-examination, Mr. Soobert?

MR. SOOBERT: I am, Your Honor. Thank you.

THE COURT: All right. Then let's bring in the jury, please.

COURT SECURITY OFFICER: Rise for the jury.

(Jury in.)

THE COURT: Please be seated.

We'll continue with the Defendants' cross-examination of the witness.

You may continue, Mr. Soobert.

MR. SOOBERT: Thank you, Your Honor.

Q. (By Mr. Soobert) Now, Dr. Kuhn, on direct, you testified about an opinion of willful infringement, do you recall that?
A. Yes, sir.
Q. Okay. And I think you used the word -- I wrote it down, you said Samsung engaged in egregious conduct. Did you say that?
A. I don't recall that at all, sir.
Q. You didn't intend to say that Samsung engaged in egregious conduct, did you?
A. I don't recall saying that, and that's not a word I commonly use.
Q. Okay. You understand what that word means, though, right?
A. Again, sir, I don't use that word. I don't know what it means. And I don't recall saying it.
Q. But you understand what it means?
A. I do not know what it means, sir.
Q. Okay. Do you know what the standard is for willful infringement?
A. No, sir.
Q. Okay. Well, you were here in the courtroom since the beginning of the trial, right?
A. Yes, sir.
Q. All right. So you were here for Professor Lee's

testimony, correct?
A. Yes, sir.
Q. You were here for the opening statements, right?
A. Yes, sir.
Q. All right. You've heard testimony and examinations concerning the relationship between Professor Lee and Samsung, right?
A. Yes, sir.
Q. All right. So you've heard a story of collaboration between the two, right?
A. There are opinions on both sides, sir.
Q. Well, they were certainly working together at times, that's for sure, right?
A. I agree, sir.
Q. Okay. And they were -- there's certainly evidence that Professor Lee was compensated for his efforts, correct?
A. I think we could debate that, sir.
Q. Okay. Well, he's certainly been paid over time; isn't that right?
A. That's unclear, sir.
Q. Well, you heard that testimony, didn't you?
A. Yes, but --
THE COURT: Counsel, your area of inquiry needs to be this witness's expert report or her personal knowledge. But a rehash of other people's testimony through this

witness is not really appropriate.

MR. SOOBERT: Thank you, Your Honor.

Q. (By Mr. Soobert) Now, you also provided opinion on benefits that the '055 patent provides, correct?

A. Yes, sir.

Q. All right. And if I understood you correctly, you're attributing the entire benefit of transitioning to the 14-nanometer FinFET by the Defendants to the '055 patent, is that what you're saying?

A. I don't recall saying that, sir.

Q. Okay. So what are you saying to frame the issue with respect to the benefit that the '055 patent provides?

A. I have talked about three distinct benefits for which I've presented evidence and analysis. The first is at least a 20 percent performance improvement. The second is at least a simultaneous 30 percent power improvement. And third is at least a 25 percent cost improvement. The last of the three is from 28 nanometers to 14.

Q. Okay. Now, all those benefits that you just summarized, you're attributing solely to the '055 patent, aren't you?

A. I'm attributing to the transistor design in the '055 patent, that's correct.

Q. Right. And in doing that, you haven't done any analysis of what the '055 patent contributes over the so-called prior art, have you?

A. I've not done a prior art analysis because it wasn't necessary in this case.
Q. Okay. So you haven't done an analysis to apportion whatever incremental benefit the '055 patent might provide over the prior art; isn't that right?
A. Well, yes, I did. I apportioned that to the transistor in my analysis.
Q. Your analysis didn't include the incremental advance of the '055 patent over, for example, Inaba in your benefits analysis, did it?
A. No, sir.
Q. Your benefits analysis didn't apportion for the incremental advance of the '055 patent over Mizuno, did it?
A. No, sir.
Q. And those are both Toshiba patents, right?
A. Yes, sir.
Q. So putting those patents aside, you attributed the benefits that you just described moments ago solely to the '055 patent, right?
A. Yes, sir.
Q. Right. And you heard the phrase at some point, haven't you, there's parts inspiration and there's parts perspiration in developing a concept? Have you heard that?
A. Yes, sir.
Q. All right. So the '055 patent provides arguably the

inspiration; is that true?
A. I would say so, sir.
Q. Did you attribute any of the perspiration in actually building that 14-nanometer FinFET, what went into that vis--vis the '055 patent?
A. It wasn't necessary in this case.
Q. Okay. So you haven't attributed it -- let me rephrase.
You haven't attributed any portion of your benefits analysis to the perspiration and the hard work that went into building that device; isn't that right?
A. That would have happened anyway.
Q. Okay. So when you were working at Intel to -- let me rephrase.
When you and others were working at Intel to implement the 22-nanometer device that you referenced in your direct exam, do you recall that?
A. Yes, sir.
Q. Okay. You spent a lot of money at Intel to develop that device, right?
A. We spent a lot of money to develop the 22-nanometer node, that's correct. The exact amount of money Intel spent on the device is confidential to Intel.
Q. Okay. You spent a lot of money to develop the node, correct?
A. Yes, sir.

Q. You had lots of engineers working on the project, right?
A. Yes, sir.
Q. How many engineers?
A. I don't know, sir.
Q. Hundreds?
A. I don't know, sir. I'd have to sit and think about it.
Q. Less than a hundred?
A. I -- I can't say at this moment, sir.
Q. You just can't say a ballpark?
A. I'd have to sit and figure it out, so...

THE COURT: Let me remind each of you to make sure the other one is finished talking before you begin to speak. We don't need either of you talking over the other.

MR. SOOBERT: Thank you, Your Honor.

THE COURT: Let's continue.

THE WITNESS: Thank you, sir.

Q. (By Mr. Soobert) The -- the investment of the resources and the time and the sweat equity and the money that went into building that 14-nanometer device at Samsung, you didn't apportion any of that value to the benefits that are achieved, did you?
A. The node would have happened anyway.
Q. So the answer to my question is no?
A. No, sir. The node would have happened anyway, sir.
Q. And instead, you attributed the entire benefit that you

described to the '055 patent alone and no other patent, correct?
A. Yes, sir.
Q. And Intel has lots of patents in this area, as well, don't they?
A. I'd assume so, sir.
Q. All right. So you didn't consider any of those patents in doing an analysis of what the '055 might provide in terms of benefits to getting to the 14-nanometer node, right?
A. I considered no Intel patents in my analysis.
Q. Yeah. You didn't consider any other patents other than the '055; isn't that right?
A. That's correct, sir.
Q. And with respect to the -- with respect to the Hafnium oxide and the High-k material we were talking about earlier --
A. Yes, sir.
Q. -- you didn't attribute any of the benefits that are achieved with the 14-nanometer FinFET to the use of Hafnium oxide, did you?
A. No, sir.
Q. With respect to the 14-nanometer FinFET devices that are accused in this case, you didn't attribute the benefit of any High-k material in those devices, did you?
A. No, sir.

Q. Whatever benefit that High-k Hafnium oxide material provides, it's not provided by the '055 patent. You agree with that?
A. Yes, sir.
Q. Now, you also offered some thoughts on what you said were commercially viable alternatives. Do you recall that?
A. Yes, sir.
Q. You know that GlobalFoundries, the Defendant in this action, offers a 14-nanometer high-performance SOI FinFET commercially, right?
A. That is 14FDX, sir?
Q. Can you answer my question?
A. Oh, wrong part number. Yes, sir, I'm aware of that.
Q. It's referred to as the 14HP?
A. Yes, sir, I'm aware of that.
Q. And that's commercially viable?
A. It's -- I would say no, sir, on that one.
Q. Okay. But it's commercially sold?
A. No, sir.
Q. It's a high performance FinFET. You agree with that?
A. Yes, sir.
Q. It's available on -- to a customer, right?
A. A single custom boutique customer, yes, sir.
Q. Okay. That -- a single custom boutique customer is IBM, isn't it?

A. Yes, sir.
Q. Okay. That's not -- that's not a mom and pop shop somewhere.
A. No, sir, I agree to that.
Q. Right. That's a big-time company in this space, isn't it?
A. Yes, sir.
Q. And they use that 14HP FinFET SOI technology today, don't there?
A. In their special Z servers, I believe.
Q. They use that technology today, don't they?
A. Yes, sir.
Q. Now, we mentioned Intel a few times. You worked there?
A. Yes, sir.
Q. And there was an Intel license you mentioned, right?
A. Yes, sir.
Q. Okay. Did you negotiate that license?
A. Absolutely not, sir.
Q. Did you make the decision to take that license?
A. Absolutely not, sir.
Q. You don't know the rationale or the reasoning behind -- let me withdraw and rephrase.
You don't know the reason why Intel took that license?
A. No, sir, I don't know that reason.
Q. That decision was made by somebody else, right?

A. Yes, sir, that's correct.
Q. Right. So you don't know whether Intel took that license to avoid litigation, do you?
A. I don't know, sir.
Q. So we've all spent a lot of time in this case, haven't we?
A. Yes, sir.
Q. A lot of time and money?
A. I'd assume so, sir.
Q. Right. A lot of hard litigation going on here?
A. Yes, sir.
Q. Right. And you don't know if Intel took that license so they didn't have to engage in this, and they could focus on developing products instead, right?
A. I don't know, sir.
Q. Okay. And you were asked to do a number of things in this case, including an infringement analysis, right?
A. Yes, sir.
Q. And you were asked to do an infringement analysis of Samsung's products, right?
A. Yes, sir.
Q. And of GlobalFoundries's products, right?
A. Yes, sir.
Q. And of Qualcomm's products, right?
A. In the sense that they use Qualcomm as a designer. So

they -- foundry with Samsung and GlobalFoundries, yes, sir.
Q. Samsung -- pardon me. Samsung makes the products for Qualcomm that are at issue in this case; isn't that right?
A. Yes, sir.
Q. Qualcomm itself doesn't make those products, do they?
A. No, sir.
Q. And you did an infringement analysis on those products which is essentially an infringement analysis of Samsung's products, isn't it?
A. No, sir. I analyzed the 14LPE/LPP transistors, which are in a variety of products that I listed.
Q. And that's Samsung technology that you analyzed, correct?
A. And GlobalFoundries.
Q. And --
A. I use -- I included many, many illustrations from GlobalFoundries.
Q. Pardon me.
So you did that analysis with respect to Samsung and GlobalFoundries's products?
A. Yes, sir.
Q. Okay. That are made for Qualcomm, right?
A. Some products are, yes, sir.
Q. Now, you didn't do an analysis of the Intel products, did you?

A. No, sir.
Q. You weren't asked to do an infringement analysis of the Intel products, were you?
A. I was not, sir.
Q. Okay. And so, therefore, you have no opinion that you've been asked to provide on the infringement based on Intel's products; isn't that right?
A. I have no opinion on Intel products, that's absolutely correct.
Q. TSMC, that's another competitor, right?
A. Yes, sir.
Q. You weren't asked to provide an infringement analysis with respect to TSMC; is that correct?
A. I was, sir, with regard to their 16-nanometer technology. And it was, I recall, a preliminary analysis because it was only off TechInsights.
Q. Okay. So you didn't have any -- let me withdraw.
You didn't have the type of data that you needed from TSMC to do the full-blown infringement analysis, did you?
A. I certainly would have preferred a richer data set, that's correct.
MR. SOOBERT: Your Honor, I'll pass the witness at this time.
THE COURT: Is there redirect by Plaintiff?

MR. CHOUNG: Yes, Your Honor.

THE COURT: Proceed with your redirect examination.

MR. CHOUNG: Can I have DX-430?

REDIRECT EXAMINATION

BY MR. CHOUNG:

Q. Dr. Kuhn, do you recognize this figure?

A. Yes, sir.

MR. CHOUNG: And could I get the top portion blown up?

Q. (By Mr. Choung) Now, the top portion here -- this is a TEM of the Defendants' transistor?

A. It's a TEM of their I/O transistor, that's correct.

Q. Thank you.

And the white band, I believe, that's the silicon dioxide.

A. Yes.

MR. SOOBERT: Object -- objection, Your Honor, leading.

THE COURT: Sustained.

Q. (By Mr. Choung) What is the white band?

A. The white band is a silicon dioxide layer.

Q. And what is the darker band above it?

A. A Hafnium oxide.

Q. Do you see two measurements here?

A. Yes, sir.

Q. And what's the first measurement?
A. The silicon dioxide is measured at 2.2 nanometers, and the Hafnium is measured at 2.13 nanometers.
Q. Are they measured at the same location?
A. It does not appear so, sir.
Q. Does that affect the measurement here if you're looking at the thickness of the layer?
A. Yes, sir.
Q. And how would it measure -- how would it affect that?
A. Because there's manufacturing variation in these layers, and if you move a little bit, you're going to get a different number.
Q. Now, Dr. Kuhn, the measurements that you took --
MR. CHOUNG: And could we pull this up, this is at 50 -- 57.
Q. (By Mr. Choung) How did you take your measurements?
A. Well, the first thing I did is I made a template so I would space these things without being affected by the measurement.
I then took the image, put the template in. And just like I would have done at Intel, I located one side of the line on the boundary between the silicon dioxide and the Fin and the other side of the line on the boundary between the Hafnium oxide and the first metal layer and the metal gate. And I did this on high resolution. And I walked

around and placed all the images without knowing the measurement values when I placed them. I just placed them based on my own years of experience in doing High-k.

Q. So you made a measurement at one location for each point along the film?

A. I -- I placed the lines. And then what I did is I went back and printed it out on high quality paper because I did not want to measure off the screen. We didn't do that at Intel. It warps things.

I printed it out. Took a pair of precision calipers, I then measured each line. And I measured the fiducial in the corner. And I went back and plugged everything into a spreadsheet to do the computation in the spreadsheet that normally we would have done in a tool at Intel.

MR. CHOUNG: So can I go back to DX-430 now, and can we blow up the top.

Q. (By Mr. Choung) So the way you measured -- so is the way that you measured in order to get the thickness of the total layer, that's different from what's shown here?

A. Yes, sir.

Q. Which would be more accurate?

A. Well, when you measure two things, as -- as machinists know, you'll get the variation of each thing together. And so if you're interested in some combined measurement,

usually a machinist will measure the total thing so that they only have the measurement variation of the single measurement.

Q. So with respect to measuring the total thickness, would this approach of measuring at two different points on the two layers and then adding them be a rigorous way of getting a correct value?

A. I wouldn't call it as rigorous as measuring the total distance. You're just going to have more variation due to your measurement.

Q. Now, Dr. Kuhn, in your time at Intel, are these the kinds of measurement --

MR. CHOUNG: Well, can we go back to 57, please?

Q. (By Mr. Choung) Dr. Kuhn, at your time at Intel, this manner of measurement, is this something you did normally?

A. Yes. As I mentioned, though, the -- at the time that I was at Intel, the robots couldn't measure things very well at all, and so we had a software tool that would do the math for you, but that software tool required the tool itself writing information into the image that would then be read by the software tool. Like many of your cameras will write the date into the photograph so can you get it later.

It was not uncommon for this tool to have the wrong information in it. The usual reason being that somebody just didn't reset the tool. And so it was not uncommon for

us to have a very high quality TEM image for which the software computing tool would not work correctly. You'd get like 30 feet or something. And so you'd sit down and do it exactly the way I described.
Q. Roughly, at Intel, how many of these types of measurements did you make over your career?
A. Hundreds maybe.
Q. And in this case, how many -- how many sets of measurements, roughly, did you make in analyzing the Defendants' products?
A. I'm trying to remember, not even all of them are in my report because I have a summary table, but I remember doing at least six Fins for each of the situations that we had an analysis. So it was multiple samples because I wanted to make sure I had a large data set.
Q. So these kinds of measurements, are you an expert in making these kinds of measurements off the TEMs?
A. I spent years doing it.
Q. Dr. Kuhn, you were shown this slide earlier?
A. Yes, sir.
Q. And on the left, they're showing the figure that we just talked about that has the two separate measurements placed at different locations, do you see that?
A. Yes, sir.
Q. And they show it compared to your measurement?

A. Yes, sir.
Q. Is this comparison at all a fair comparison of what you did?
A. No, sir.
Q. Dr. Kuhn, earlier, you testified that -- that these scales were talking about things that -- I think you used the analogy of marbles, all right. And so what accounts for this -- the differences in the values?
A. Well, if you think about a Fin, and if you're wrapping these marbles around the Fin, there's going to be one or two atom variations even in a very healthy process. So you're going to see some level of manufacturing variation even in an extremely healthy uniform process.
Q. All right. And so when you're making your measurements, you need to take a fairly large sample of the film to get reliable data?
A. Yes, sir.
Q. And what about on the upper surface of the film?
A. Well, when I started doing this, immediately I recognized that there was no data available from Samsung and GlobalFoundries that had enough data points. There was one excellent GlobalFoundries picture, SEM 236, and that was it. That's when I started measuring a number of Samsung and GlobalFoundries samples to get a large enough data set. And I expanded that data set to include multiple measurements at

the top of the Fin, one in the middle, and then two off on the edges in order to be as fair as possible.
Q. And the claims refer to the upper surface of the Fin, correct?
A. Yes, sir.
Q. All right. So in order to make the comparison between the side-walls and the upper surface, you need more than one point on the upper surface?
A. Yes, sir.
Q. The claim does not say the tip of the Fin, does it?
A. No, it does not, sir.
Q. You were asked about the 14HPSOI --
A. Yes, sir.
Q. -- process. There's only one customer for that?
A. That's correct, sir.
Q. When was that available?
A. I believe it was the second half of 2017. It's been in the near recent time frame.
Q. Okay. So not in the 2014/2015 time frame?
A. No, sir.
Q. All right. And does anyone else in the world use that particular process?
A. No, sir. I believe it's part of some special deal, which is why I said not commercially available because I believe it was custom for IBM alone.

Q. And is there an expression for what you call such boutique or custom-tailored process?
A. I called it golden toilet once.
Q. Dr. Kuhn, you were asked if you had conducted any analysis on the Intel chips. Do you recall that?
A. Yes, sir.
Q. Given your previous employment with Intel and your position, ethically speaking, could you have done that kind of analysis?
A. No, sir. I actually expressed concern at my deposition that if there were such questions asked, I'd need to go seek help from Intel legal.
Q. Dr. Kuhn, I'd like to talk about the Hafnium oxide that's been coming up quite a lot now. I believe you testified earlier that Intel innovated that feature?
A. Yes, sir.
Q. And that was something that you worked on directly, you innovated that feature?
A. I was head of the transistor group that made that feature successful, yes, sir.
Q. And that was done on a planar node or a planar transistor?
A. Yes, it was, sir.
Q. Was it part of the planar transistors all the way down to the 20 nanometers?

A. Yes, sir. Once we got it to work, it just replicated forward.
Q. So it was a big deal for the progression of the trans -- the planar transistors?
A. Well, remember, when you -- when you get one of these features in, once it's in, part of the assessment for it is that it will survive through multiple generations. No manufacturer wants to put in some fancy feature and have to pull it out the next time around.
And the idea is when you spend the energy to put the new feature in like the High-k metal gate process, you want it to replicate in subsequent generations in a very straightforward fashion, or you're doing this massive amount of redevelopment every time.
So all of these things like the Intel string layer process, the High-k metal gate process, and the FinFET itself is you put all this energy into the first time you do it, and then it just kinds of trucks along in sort of a manufacturing mode.
Q. All right. So when Samsung tried to implement the 20-nanometer planar transistor, that Hafnium oxide, that had been around?
A. Oh, yes, sir.
Q. And so that was implemented into the 20-nanometer node?
A. Now, here I'm going to speak without full assurance.

And this is from my experience at Intel, and I may not have the details quite right. But my understanding is that Samsung first adopted IBM's version of High-k on 32 and 28, and then switched to Intel's version on 20. And I'm not a hundred percent sure of that, but they may have done two different High-k processes over the course of the time frame here.
Q. But that involved applying the Hafnium layer?
A. Yes, it did. And my point is Intel did it once and stayed with it. It's distinctly possible that Samsung did it twice.
Q. Okay. 20 nanometers, the planar transistor, I believe you testified earlier that failed?
A. Yes, sir.
Q. All right. So the Hafnium oxide -- well, let me -- let me reframe that for you.
The FinFET -- the transmission to the FinFET, was that based on the Hafnium oxide?
A. No, sir. As is often true with these introductions, you put them in, you get a significant amount of benefit the first generation, and then you squeeze the blood out of the stone the next generation. And then you got to do something else. You can't take out because you lose everything, but you're kind of done with getting more innovation out of that.

So if you look at, for example, Intel's progression, we put in the string layer transistor in '90, we squeezed the blood out of the stone in '650, okay, everyone past that still had strained transistors, but it just kinda clock along. Then we put in High-k at 45, squeeze the blood out of it at 32. It's still there clocking along, but then we had to put in the FinFET in order to keep moving down the Moore's Law progression.
Q. So 20 nanometers, even with the Hafnium oxide layer being implemented, Samsung, GlobalFoun -- Samsung and the other industry leaders that implemented 20 nanometers, those still failed?
A. Yes, I -- I am not for positive because I have to go do research on this, but I believe that all of those failed technologies had High-k.
Q. So for the transition -- in order to get past the roadblock to move to a lower node, was the innovation the Hafnium oxide or the bulk FinFET design?
A. The bulk FinFET.
Q. So let's turn to the benefits that you discussed. Given what you just testified about the Hafnium oxide layer, is there any way that's tied to the benefits attributable to the bulk FinFET transistor development?
A. No, sir.
Q. Now, earlier you testified -- and I believe these are

the numbers you gave -- 20 percent performance improvement, 30 percent power improvement, and 25 percent in cost savings; is that right?
A. With the caveat that the cost savings is the double jump, so it's not as clean as the other two numbers.
Q. Thank you. Thank you for clarifying that.
Where do those benefits come directly from?
A. The benefits come from the transistor.
Q. Is there any need to apportion out from there the benefits that come from something else?
A. No. When I started the analysis, I was concerned that such an apportionment would be necessary and concerned that it might be very difficult to do with the data I had available. And then I sort of sat down and said, well, let's look at the data before I panic here. And the data was startlingly clear in this case.
The 20-nanometer to 14-nanometer transition, the data fell out very crisply where the improvement in performance and power had been attributable directly to the transistor.
Q. So if we refer to, for example, a company's processing technology, you're not saying there's no benefit from that, are you?
A. They have to do that anyway because if we look at this generational thing, it's like you've got to put that next

generation out anyway, whether you went to FDSOI and the magic wafer or you went to something else that, you know, someone invented some wonderful new transistor technology. All the rest of the infrastructure has to happen anyway because that's the way Moore's Law works, and that's the assumption of the industry.

Now, of course, if you didn't go to the next generation, that's a whole different set of assumptions. But in general we assume that there will be a next node and that all the infrastructure has to happen anyhow.

Q. So the benefits that might allegedly be attributable to some other technology, that's just not coming out -- well, strike that. Let me rephrase that.

So the benefits that might be attributable to some other technology, that's just in a different universe from what you're calculating, is that a fair statement?

A. "Universe" is a little odd. But let me put it this way. Again, I'm going to stick by what I said before.

Because of the way the industry is structured, there is going to be another node, and so there's the expense of going into manufacture. They are going to run another node no matter what. And it's not fair to attribute the cost of what is going to inevitably happen.

If they kept with the same transistor, they would have run another node. They could have always kept the 28

device and redone their design rules in some spectacular way, and generated a new node. It would be a little weird looking, and it might not have good performance, and it might have a whole lot of other problems, but they could have done that.
Q. All right. Now, would you be able to compare the benefits to a device that doesn't work?
A. Not easily.
Q. Defendants' counsel mentioned a number of prior -- pieces of prior art. Do any of those work?
A. No, sir.
Q. In fact, among those are -- are -- are there some that are not even complete devices?
A. Yes, sir.
Q. Okay. So you couldn't very well calculate benefits from a -- from something that doesn't actually work?
A. That's correct, sir.
Q. All right.
MR. CHOUNG: Could I have the slides PDX-3.55, Slide 55?
Q. (By Mr. Choung) Now, earlier, you recall you were asked about the claim term "wall-shape"?
A. Yes, sir.
Q. And you were asked to look at expressions in the patent that called it the wall-shape, the length of the channel?

A. Yes, sir.
Q. Is that what this figure shows?
A. Well, this figure certainly shows the walls. You can very clearly see the walls of the Fins coming down here.
Q. All right.
MR. CHOUNG: Can we get DX-1?
Can we go to Figure 12, 12d.
It's DX-1 at 18.
Thank you.
Q. (By Mr. Choung) Figure 12d, this is from the '055 patent?
A. Yes, sir.
Q. And what does this figure show?
A. It shows a bulk FinFET device with an oxide wrapping around the device with the top a little bit thicker.
Q. And what does it show in terms of the shape of the Fin?
A. It shows that the Fin is widening as it approaches the substrate, as seen in this drawing.
Q. All right. So you're referring to the curving outward as the size of the Fin come down?
A. Yes, sir.
Q. All right. So this is expressly described in the patent; is that correct?
A. Oh, yes, sir, absolutely.
Q. All right. And is this the wall-shape?

A. Yes, sir.
Q. Now, earlier, we talked about Claim 15, do you remember that?
A. Yes, sir.
Q. All right. Do you remember what that claim -- what feature that claim added?
A. Yes, that's the claim with the chamfered corners that the Court has interpreted as being beveled or rounded.
Q. All right. And in this figure, what would that do to the shape?
A. Let's see if I can do this. I can't quite draw.
It would round the top in a similar way to what we've seen in the TEMs.
Q. All right. So then you would have a rounded top, and then the Fin comes down and enlarges out?
A. A flaring bottom, yes, sir.
Q. All right.
MR. CHOUNG: Can you put up DX-430 again?
Q. (By Mr. Choung) And is that the same shape?
A. Pretty much, sir.
Q. And is that what you analyzed in your earlier testimony when you walking through your infringement analysis when you looked at this element, were you -- were you analyzing the wall-shape with respect to the entire shape of the Fin as it is in the accused products?

A. Yes, sir.
Q. Okay. Now, let's talk about -- let's talk about the combination of the silicon dioxide and Hafnium layer.
A. Yes, sir.
Q. Now, the claims don't require -- strike that. Let me phrase that better.
What kind of oxide layers do the claims require?
A. The claims simply require a gate oxide on the side and the first oxide on the top. They specify nothing beyond that.
Q. All right. And does the silicon dioxide and Hafnium layers provide the gate oxide and the first oxide layers?
A. Yes, the way we think about --
MR. SOOBERT: Objection, form.
THE COURT: Sustained.
Q. (By Mr. Choung) Does the silicon dioxide and Hafnium layers provide the gate oxide layer?
A. Yes, sir.
Q. All right. How do they contribute to the function of the gate?
A. So both the silicon dioxide and the Hafnium dioxide are necessary for operation of devices. At these channel lengths, if you remove either layer, the devices don't work properly. And so you need to have both of those to have a layer that fulfills the gate oxide as one would think of it

from a POSA's standpoint.
Q. And can either one of those be a gate oxide?
A. By itself, yes. I mean, you can go off and make silicon dioxide gates. People have been doing that for 45 years.
You can also go off and make Hafnium oxide gates. People have done that research. They don't work very well by themselves for complex reasons.
But at this geometry, both of them are necessary in order to have the performance and power that you need in these small devices.
Q. And the claim says "a gate oxide," right?
A. Yes, it does, sir.
Q. And so that can be one or more?
A. Yes, sir.
Q. So it could be one or more gate oxides like silicon dioxide and Hafnium?
A. Yes, sir.
Q. All right. Dr. Kuhn, earlier, you were asked a series of questions comparing the claims to the specification and the figures in the claim -- in the patent, do you remember that?
A. A few minutes ago, you mean?
Q. By Defendants' counsel?
A. Yes, sir.
Q. My apologies.

A. Yes, sir.
Q. In your analysis, you applied the claims to the accused products?
A. Yes, I did, sir. I used as much data as I could get from the Defendants and the addition of TechInsights to apply each claim to specifications from the Defendants, as well as images and testimony, as much information as I could get for each claim.
Q. All right. So -- and you went through some rules of how you conduct the infringement analysis, and you're not supposed to compare the products to, for example, the figures?
A. That's my understanding, sir.
Q. All right. And so you applied the claim language to the products?
A. Yes, I did, sir.
Q. All right. So Dr. Kuhn, one last question, the work you did at Intel, you were at every phase of a commercialization of a product, correct?
A. Is this for High-k or for FinFET?
MR. SOOBERT: Objection, form.
THE COURT: Just -- just a minute.
I'll sustain the question as to a leading question. This is direct examination.
Refrain from leading the witness, counsel.

MR. CHOUNG: Yes, Your Honor.
THE COURT: Restate your question.
Q. (By Mr. Choung) Dr. Kuhn, at your time at Intel, what were you all the phases of development and commercialization that you worked on?
A. In totality, all projects?
Q. Yes.
A. Oh, okay. When I first joined Intel, I worked in pure manufacturing. In the parlance of the era, I ran -- I worked at the manufacturing floor, I worked with manufacturing technicians. I came in at 6:00 in the morning for passdown and left at 6:00 at night after passdown. I worked a pure manufacturing floor, as many of you folks are probably familiar with.
And then I got promoted out of that, and I ended up in the development cycle where I worked on 130 nanometers. And at that point, I worked as a senior engineer on one module of the process.
And sort of the same thing, was in at 6:00 in the morning, we had passdown at 6:00, and same sort of thing. That was development. That was four years or so long.
And then I began to advance in the company at -- I'll skip some steps in between to afford boring everybody. And when I did 45 nanometer, I was in charge of the development cycle. I ran the transistor development

activity.

And at that point, I started on like the first day of pathfinding, and I moved on after we hand it off to manufacturing in what's called the sync point, which is when you get it to the manufacturing guys, and you've done the copy exactly, and it's in their hands, and you run off to do something else.

And then after 45, as I mentioned, I turned into a fellow. I did the FinFET project, which was a mixed development research project because I was assessing the transition between research and development.

And then after that, I did a number of research projects, some of which I think are still confidential to Intel, and I can't talk about.

Q. Thank you, Doctor.

MR. CHOUNG: We pass the witness.

THE COURT: All right. Is there additional cross?

MR. SOOBERT: There is, Your Honor. May I proceed?

THE COURT: You may proceed.

MR. SOOBERT: Mr. Dahm, may I have Slide 9?

RECROSS-EXAMINATION

BY MR. SOOBERT:

Q. All right. Dr. Kuhn, counsel asked you about the first oxide layer and the requirements of the claims just a moment ago, do you recall that?

A. Yes, sir.
Q. All right. The first oxide layer -- layer specified in this Claim 1, in this Claim 1 -- and let me rephrase.
This limitation appears in every asserted claim at issue in this case, right?
A. Yes, sir.
Q. And we already established -- I don't want to rehash, but the claims define the invention and Professor Lee and the Plaintiff need to live by the words in the claim. You understand that?
A. Yes, sir.
Q. So this claim limitation is very clear and says a first oxide layer which is formed on the upper surface of said Fin active region. You see that?
A. Yes, sir.
MR. SOOBERT: Slide 13, please.
Q. (By Mr. Soobert) Now, these measurements on the right-hand side that you put on, you put them on by hand, right?
A. Yes, sir.
Q. And, again, you didn't send this out to a third party to do this analysis, you did it yourself?
A. No, sir, I didn't. And, yes, sir, I did.
Q. And you said you attempted to do it the same way that Intel does it, right?

A. For a manual measurement, sir.
Q. Not using a robot?
A. Neither using a robot, nor using the special tool that comes with the TEM because I didn't have access to that.
Q. And you also left Intel about four years ago, right?
A. Yes, sir.
Q. So the machines -- how often do they change those machines out?
A. I would say every technology generation. So every two years.
Q. So you left four years ago?
A. Yes, sir.
Q. Two generations ago?
A. Yes, sir.
Q. So the machine that's making measurements when you left and the techniques that you're using by hand, it's two generations old, isn't it?
A. One could say that, sir.
Q. And we've established and counsel asked you that -- some questions about Hafnium oxide. The device wouldn't work, the 14-nanometer range, without the Hafnium oxide, right?
A. Not successfully, sir.
Q. So you take that Hafnium oxide out, that device has no value, right?
A. Well, it certainly wouldn't work, and I would assume it

would have no value under the circumstances.
Q. Right. It wouldn't work, right?
A. That's correct, sir.
Q. And it would have no value commercially; isn't that right?
A. A non-functional device has no value, sir.
Q. Okay. And you didn't attribute any of that value that was to that Hafnium oxide device, but if you remove it, the device becomes useless, right?
A. No, sir, I didn't attribute the Hafnium -- let me see. Can you rephrase that, sir?
Q. You didn't attribute any of the value of the device -- let me withdraw and rephrase.
You didn't attribute any of the benefits to the device to that Hafnium oxide layer, right?
A. No, sir.
Q. And all the value is gone when you take it out, right?
A. Yes, sir.
Q. You looked at the Samsung 10-nanometer process, too, didn't you?
A. I did a preliminary analysis on it, yes, sir.
Q. Is there a High-k layer in there?
A. I don't actually recall. I was so focused on the Fins, I didn't know.
Q. Okay. You don't know one way or the other?

A. I don't know one way or the other.
Q. Now, the patent requires a Fin active region that's a wall-shape, right?
A. Yes, sir.
Q. Okay. And we -- counsel asked you about rounding corners, chamfering, right?
A. Yes, sir.
Q. When you chamfer, you still need to have a wall-shape Fin active region, right? That's still a requirement?
A. Yes, sir.
MR. SOOBERT: I have no further questions at this time, subject to any further redirect.
THE COURT: You pass the witness? Counsel, you pass the witness?
MR. SOOBERT: I apologize, Your Honor. I pass the witness.
THE COURT: All right. Is there further direct from the Plaintiff?
MR. CHOUNG: No, Your Honor.
THE COURT: Then you may step down, Dr. Kuhn.
THE WITNESS: Thank you, sir.
MR. SHEASBY: Your Honor, may we clear the binders?
THE COURT: Yes. We'll take a moment, clear the binders.
All right. Plaintiff, call your next witness.

MS. WEN: Plaintiff calls David Witt, Your Honor.
THE COURT: All right. If you'll come forward and be sworn, please, Mr. Witt.
(Witness sworn.)
THE COURT: Please have a seat, sir.
THE WITNESS: Thank you.
THE COURT: You may proceed with your direct examination, Ms. Wen.
MS. WEN: Thank you, Your Honor.
THE COURT: And you may also stand at the side of the podium so you can see.

DAVID WITT, PLAINTIFF'S WITNESS, SWORN

DIRECT EXAMINATION

BY MS. WEN:
Q. Mr. Witt, could you please introduce yourself to the jury?
A. Yes. Good afternoon. My name is David Witt.
Q. Where do you live?
A. I live in Plano, Texas.
Q. How long have you lived in Texas?
A. Over 35 years.
Q. And are you married?
A. I'm married, and I have four children.
Q. Have you ever been an expert witness in a litigation before?

A. Never before.
Q. Are you being paid for your work on this case?
A. Yes. I have rate of $250.00 an hour.
Q. And is that compensation contingent on the outcome of this case?
A. Not at all.
Q. And how many hours have you worked so far?
A. Approximately 170.
Q. Have you prepared any demonstratives for your presentation today?
A. I have. And with any luck, they'll come up. Okay.
Q. What is your professional background?
A. Okay. It's -- it's summarized here. But I got a Bachelor of Science in electrical engineering from University of Wisconsin.
After that, I went directly into the semiconductor industry. I worked there for over 30 years. I've worked at large semiconductor manufacturers, such as Texas Instruments, Advanced Micro Devices, and Motorola. I worked on high end X86 microprocessors, as well as at TI, smartphone SoCs directly like the ones that Qualcomm and Samsung manufacture. I've led worldwide teams of over 300 engineers when I was at TI. I've worked on over 20 devices that have gone into high volume manufacturing, represented in billions of devices all over the world.

Q. And could you remind the jury what SoC is?
A. Oh, yes. Sorry. SoC -- you've probably heard that a couple of times -- that stands for system on a chip. The way to think about it is all you guys have had PCs or -- I've certainly have have had a few. If you take all that, the -- the computer, the X86 processor, the graphics card that your sons and daughters probably use because there's a GPU on it, the camera display, you take all that hardware and you shrink it all down into a very small 10 millimeter by 10 millimeter chip, so it's all the functionality on -- an incredible small area. That's what an SoC is.
Q. And have you designed every part of an SoC like you just described?
A. Yes, every part.
Q. And in your leadership role at Texas Instruments, did you ever deal with the cost of different process technologies?
A. Yes, absolutely. It's a trade-off that we had. An example would be a number of metal layers or where we set a particular transistor threshold. Those are the kind of things we would do at TI.
Q. And have you invented any patents?
A. Yes. It's shown here. Roughly a hundred patents -- just over a hundred patents, all related to chip design. All my time at Advanced Micro Devices.

Q. And what are you currently working on?
A. So I am working on a small startup called My Replica Technology. My two other co-founders and I are building a computer vision processor. That's really exotic thing to try and make computers see. That's a very important problem. And, believe me, it's very hard. What you and I take for granted is very, very hard for a computer to do.
Q. And do you have expertise on assessing the performance impact of transistors on chips and mobile -- mobile products?
A. Yes, it was part of the job at Texas Instruments. We -- we had -- comparing our -- our currently generation with -- with -- with -- with our previous generation. We looked at billions transistors and run benchmarks to see how much better they were. So very similar to what I've been asked to do here.
THE COURT: Let me ask both of you to slow down just a little bit, please. We'll all benefit.
THE WITNESS: Sorry.
MS. WEN: Sorry, Your Honor.
THE COURT: Let's continue.
MS. WEN: And, Your Honor, I'd like to offer this witness as an expert in the field of processor performance and the management of chip development.
THE COURT: Is there objection?

MR. KENNERLY: No objection, Your Honor.

THE COURT: Then the Court will recognize the witness as expert in those designated fields.

Continue, Ms. Wen.

Q. (By Ms. Wen) Mr. Witt, what was your role in this case?

A. Okay. So it's summarized here. But it's really to evaluate the benefit of the 14-nanometer bulk FinFET transistor as deployed in the 14-nanometer SoCs from Samsung and Qualcomm, and comparing to that to the next best planar devices at 20 nanometers or 28 nanometers. And at these geometries, there's actually billions of transistors in these SoCs.

Q. And what information did you review as part of your assignment?

A. So I'm an expert witness. So I was given the access to the Defendants' confidential documents, as well as the deposition. You probably heard several of those today.

I had internal benchmarks that I received from -- from Qualcomm, as well as the Defendants' public marketing documents. And -- and then just some independent analysis of Samsung and Qualcomm benchmarks.

Q. And have you done this type of analysis before?

A. Yes. It's part of the job at Texas Instruments.

Q. Did you analyze the '055 patent infringement or validity?

A. No, that was Dr. Kuhn. She's a worldwide expert in infringement and validity. I was just looking at the real-world benefits of the billions of transistors we talked about and showing what performance improvement and power performance would be for that.

Q. So based on your investigation, what overall conclusions have you reached about the benefit of the 14-nanometer FinFET transistor?

A. So they're summarized here. But just high-level, there is significant speed and battery life benefits at the SoC levels for the accused chips.

Q. And do you have an opinion one way or another about whether the benefits you described are attributable to the 14-nanometer FinFET transistor?

A. Yes. In my opinion, they're all attributed to the 14-nanometer FinFET. The devices had to get down to 14 nanometer. There was no other way of building competitive devices at 14 -- without the 14-nanometer FinFET.

Q. Have Defendants discussed whether the benefits that you observe come from the FinFET transistor design?

A. Yes. This is one of those public marketing documents. This is from Samsung. And I'll just read the highlighted text. This is PX-138: The advantages to the 14-nanometer FinFET platform is a result of utilizing 3D FinFET

transistors.

14-nanometer bulk FinFET. This is Samsung's view.

Q. And was Samsung the only Defendant that discussed the relationship between the FinFET transistor and any performance advantages?

A. No. The jury's probably seen this several times already, but this is that internal document from -- from GlobalFoundries. So this is for engineers like myself would see this document.

And the highlighted text there, it's talking about the end of bulk CMOS scaling and planar CMOS hitting hard scaling limits at 20 nanometers.

So what -- this is PX-0807. So what this is telling you is the planar device you see on the left was actually used from the late 1960s all the way up to around 2010. And pretty much regularly like clockwork every two years you get a shrink that would double the number of transistors, lower the voltage, reduce the cost, allowing the performance and -- and power and cost benefits that drove the semiconductor industry everywhere.

At 20 nanometers, so the second bullet there, they start hitting hard scaling limits, which you heard about this morning.

And -- and they had to come up with a radical solution. That's -- that's what I would call it, which is

the three-dimensional FinFET transistor you see on the right that enabled the gate-level shrinking under 20 nanometers. That was fundamental for the semiconductor industry.

Q. Do chip manufacturers have a view on the ability to shrink transistors like you just described?

A. Yes. This is kind of a marketing slide. But -- so all the happy stuff.

But this is the -- what I did at -- at Texas Instrument. I was in the smartphone industry, and so our job was to build the -- you know, the smartphone handsets that every year you'd want, you know, a -- you know, a really cool new feature in it.

So -- so on today's smartphones, you can do 60 frames per second, 1080p recording, or download Netflix and have it displayed and be able to -- to see that for hours. A few years ago, that was just unimaginable, that kind of performance.

The way that you achieve those new features was smaller transistor, doubling transistors year after year after year. So the only way that we were able to provide all those features in those new smartphones was smaller transistors, just hard stuff.

Q. So did you come to any conclusions about why Defendants adopted the 14-nanometer bulk FinFET transistors?

A. They adopted the 14-nanometer bulk FinFET transistor to

continue business after 20 nanometers. 20 nanometers was just very unsuccessful, the last planar node. They needed this to get back on track.

Q. And what technologies did Defendants use before adopting 14-nanometer FinFET transistors?

A. The planar SoCs that they've talked about, those are what the SoCs were based off of. Samsung built 28-nanometer planar and 20-nanometer planar SoCs, their Exynos line.

Qualcomm built 28-nanometer and 20-nanometer Snapdragon. That's their SoC smartphone line. But they had incredible problems, extreme problems with their 20-nanometer Qualcomm Snapdragon devices.

Q. And why do you say that they had extreme problems with their 20-nanometer chips?

A. So with that, I'll -- I'll turn to this slide, which actually is -- this is a Qualcomm marketing document actually explaining the problem.

The -- the yellow line that you see kind of going down into the right represents what the market requirements are. The performance and power in cost going -- increasing, which is kind of seen, the line going down over time.

Lower is better, so you're below the line, you're meeting or exceeding what the market requirements are. Above the line is you're not providing what the customer wants.

And this is PX-0522. You see the highlighted red there, and what that actually is talking about is that Snapdragon SoCs and the performance power. So the -- the -- the blue bars represent the chips, the -- the -- you know, each individual chip at each generation.

Staying under the line is the goodness. But there, you can see the 20-nanometer where you're expecting the performance and power to get better, it's really basically no better than 28-nanometer device.

And you see it getting back on track at 14 nanometers. And so you see a 28-nanometer hitting the performance goals, 14 nanometer hitting the performance goals.

And you recall from Dr. Kuhn talking about jumping a generation, two generations. There you can see it physically in Qualcomm's own marketing slide, getting back on track at 14 nanometer with the FinFET.

Q. And did you review any other commentary on the market's view of 20-nanometer technology?

A. So this is PX-483. This is AMD's view. They're a long-time GlobalFoundries customer. And -- and, again, this is their slide.

You can see there 28-nanometers, they're building GPUs. AMD's rating group builds GPUs. They go on to those graphics accelerator cards.

And you can see there, 28-nanometer planar, and they skip completely and go directly to 14-nanometer FinFET.

If I just read the -- the highlighted text, this is from AnandTech. The highlighted text says: The 20-nanometer planar process proved unsuitable for GPUs. The failure of 20 nanometers has essentially stalled GPU manufacturing improvements.

This is AnandTech and AMD's view of what 20-nanometer planar was and its success for getting back on track, 14-nanometer FinFET.

Q. Could you explain what AnandTech is?

A. Yes, I'm familiar with them. We used them extensively at Texas Instruments. They're kind of the gold standard. They do independent benchmark analysis of the latest and greatest PCs or smartphones and tablets compared to the previous generation. So you can see what the relative performance and power gains from generation to generation is.

Q. And were you able to find any information about the cost associated with 20 nanometers?

A. Yes. For this, I'll turn to one of the depositions. This is Dr. Vadi. He's a Qualcomm engineer.

And, again, I'll just read the quote, what's -- what's highlighted in red. He's talking about 28-nanometer compared to 20-nanometer.

20 was actually a very expensive technology node. 20 is one of the most expensive technology nodes, significantly more expensive than 28 nanometers.

This is Qualcomm's view of the cost of 20 nanometers. So performance and power was no better than 28, and it was significantly more expensive. 20-nanometer planar was a failure.

Q. So what did you do to evaluate the benefit of the 14-nanometer bulk FinFET transistor?

A. I used the same methodology or -- what I used at Texas Instruments to compare our -- our next generation versus our previous generation, as well as our competitor. I used standard benchmarks that measure key factors that you care about in smartphones and -- as well as internal benchmarks.

Q. And as you're comparing Defendants' 14-nanometer chips with their 20 and 28-nanometer planar chips, what attributes that are important to smartphones did you consider?

A. So these are the three attributes I did, and they should be familiar to -- well, to me. But CPU performance -- this is web browsing, so everyone wants your web pages to -- to come up faster. That's what this CPU performance will show.

Battery life, everyone wants all these cool features to kind of last forever, so measuring battery life is very important.

And GPU performance, that's actually that Netflix

video. That's based on the GPU. Any graphic games that you want to play on your phone, that will be the GPU. And the fact the entire user interface, what you actually -- appears as the display, that's all based on the GPU. I compared these three factors.

Q. And do you have an opinion about the impact of the 14-nanometer FinFET transistor on CPU performance in Samsung's chips?

A. Yes. This is the AnandTech benchmark. We talked about them before. This is really a good one because this is comparing Samsung Exynos SoCs at 20-nanometer compared to 14-nanometer. And it's actually just looking at the processor of CPU cores for a fixed amount of power. And for that fixed amount of power, the same cores, how much better or faster would they run in -- in 14 nanometers compared to 20.

So here we see 18 to 25 percent improvement. That's directly related to the 14-nanometer FinFET. This is PX-0500.

MS. WEN: And at this point, Your Honor, I believe the Defendant would like to seal the courtroom. We're about to go into some confidential --

THE COURT: All right. Is that correct, Mr. Kennerly?

MR. KENNERLY: We may not need that, Your Honor.

May I approach?

THE COURT: Well, if either of you want to request the Court to seal the courtroom, do so. But don't speak for the other. If it's time, if you believe we're fixing to go into confidential information that needs the protection of the sealing process, let me know. If not, we'll continue.

MR. KENNERLY: With the same understanding that was expressed on the record with respect to Dr. Kuhn -- that is, at the level of the demonstratives that we've seen, we do not make a request to seal. If something goes below that, then we have to consider that.

THE COURT: Without a request directed to the Court, we'll continue without the courtroom being sealed.

MR. KENNERLY: Thank you, Your Honor.

THE COURT: Let's continue.

MS. WEN: Thank you.

Q. (By Ms. Wen) Do you have an opinion about the impact of the 14-nanometer FinFET transistor on CPU performance in Qualcomm chips?

A. Yes, I do. This is a spreadsheet showing a large number of Qualcomm's internal benchmarks. So this is their view of what the relative benefit is. The one I'm showing here is processor speed impact of the Qualcomm benchmark. And comparing 28 planar to 14-nanometer FinFET, Qualcomm's benchmarks said -- showed a 23 percent improvement in

processor speed ignoring power. That 23 percent processing speed from 28 to 14 is directly related to the 14-nanometer FinFET.

Q. And why did you use Qualcomm's 28-nanometer planar data instead of -- instead of 20 even though you used 20 for Samsung?

A. So as -- as described before, from the slide from Qualcomm, 20-nanometer was really no better performance in power. It -- Qualcomm's own word, it wasn't a successful node. So I'm using the baseline which is 28-nanometer of their last successful Qualcomm Snapdragon SoC.

Q. And do you agree with the performance numbers on this spreadsheet?

A. I -- I agree with them, but I think they're actually conservative. This is PX-0822. This is talking about relative clock speed independent power. It can be much better if you factor what power is, as well as processor speed.

THE COURT: I'm going to ask both of you to slow down, please. All right?

MS. WEN: Yes, Your Honor.

THE COURT: It's important that the jury follows the testimony, and at the rate of speed you're both talking, I have a concern that that's going to be difficult to do. So please talk more slowly, all right?

THE WITNESS: Yes, sir.

MS. WEN: Yes, Your Honor.

THE COURT: Let's continue.

Q. (By Ms. Wen) What is your opinion on the impact of the 14-nanometer bulk FinFET transistor on battery life in Qualcomm's chips?

A. So, again, this is a Qualcomm benchmark. And this spreadsheet is -- is the results from that Qualcomm benchmark. Here they're talking about battery life benefits, and battery life benefit has an internal days of use, how much that you spend on a call, how much that you play games, how much you do video, how much you don't spend any time doing anything at all. That's what a battery life benchmark is.

Again, using 28 to 14, they show a 45 percent benefit in -- in -- in -- at the SoC level in their benchmark. That's actually as is shown here at the chip level or the SoC level.

What matters to the end user is what you see at the phone level. And at the phone level, that SoC is going to be driving speakers or displays, so roughly half of that benefit that you see at the chip level, you'll see to -- to the consumer at the phone.

So that's where the 22 and a half percent improvement, half the 45 percent comes from. That's a -- a

good estimate of battery life at the phone level. And, again, that's due to the FinFET. That's due to the 14-nanometer compared to the 28-nanometer. This is PX-0822.

THE COURT: That's much better. Thank you.

THE WITNESS: Thank you.

THE COURT: Let's continue.

Q. (By Ms. Wen) And were you able to assess the impact of the 14-nanometer bulk FinFET transistor on battery life in Samsung's chips?

A. Yes. It's -- it's very similar. The only difference was Samsung actually successfully shipped some 20-nanometer devices. So the benefit's roughly half. That's a more aggressive process technology. The 45 percent at the chip level would be roughly 22 and a half percent. And you'd see a 12.375 percent improvement in battery life at the phone level for the Samsung Exynos device. Again, you know, a day of use or battery life for Samsung will be very, very similar to what it'd be for Qualcomm.

Q. And --

A. Go ahead.

Q. Now, is there a way to quantify these battery life benefits that you've been talking about in terms of speed or performance?

A. Yes, absolutely. This is a design rule, if it ever will advance. We use this design rule at Texas Instruments when

I was there for smartphones. And -- and what it is, is just a way to quantify the benefit of any particular feature that's -- that you're adding. If you add something, like say that video that we talked about before, well, that's going it take some amount of physical area, as well as power.

So any additional benefit that you're putting on the chip, you want it to have a minimum -- in our particular case, it was 2X or better speed performance for that incremental amount of power.

The other side of that is if you save any battery life, which we kind of did in the previous benchmark, well, then you can take whatever you saved in power from the battery life, and then multiply that up by 2X for what that's worth in speed performance. So that's relating battery life gains to what you could use for performance.

So the battery life power that we saw on the previous slide then just gets multiplied up by 2X to show this is what I could do to use that for relative performance. That's what we used at TI.

Q. And so taking this design rule into consideration, could you please summarize your opinions about the speed and battery life benefits of the 14-nanometer bulk FinFET transistor?

A. Yes. It's all summarized on this slide.

The Samsung Exynos, if you recall, that was a 20-nanometer to 14-nanometer SoC comparison. There with AnandTech we saw 18 to 25 percent improvement in max megahertz. We saw 12.375 percent battery life. And, again, with that 2X multiplier, that would be 24.75 percent battery life converted to performance.

Qualcomm Snapdragon, this is 28 to 14, the last good node we could compare to. Their own benchmarks was 23 percent for what the max megahertz benefit was. 22 and a half percent on battery life -- again, their benchmark. And then that 2X factor, 44 and a half battery life converted to performance. These are very conservative numbers. The user benefit will actually be much greater. We haven't actually looked at all of what the GPU benefit would be, and that drives all the graphics.

Q. So then, Mr. Witt, what is your opinion about the impact of the 14-nanometer bulk FinFET transistor on graphics performance?

A. It's shown on this slide. This is AnandTech again. This is their benchmark. And this is a graphics-related benchmarks. It's actually running a game. And the faster the game runs, the better it is.

But they're actually looking not this -- so much how much faster the game runs but how much power it takes.

And -- and you can see here in PX-0501 there's

actually when you look at performance over power for 20 nanometers to 14 nanometers, they're seeing 77 percent improvement in GPU performance on this benchmark.

And so why that's true is -- is this is kind of how GPU works, the graphics unit is, so you can think about them as if RAM is over here and you have GPUs over here, the more GPUs you have, really, which you can think about is hands, as shown there, and you grab from the RAM, and you pull over here, you manipulate a little, and you actually have to put it back in the RAM.

So the GPUs kind of work like hands grabbing, processing, and back. But the more hands you have and the faster the hands run, the faster the graphics is, it's just that. That's video, that's games, that's the user interface, that's everything.

And so that's -- if you look at the 20-nanometer Exynos device here, they had 6 GPU cores running at 700 megahertz in -- in -- in a fixed amount of area. And then in a smaller amount of area, because of the 14-nanometer FinFET, they now have 8 GPU cores running at 800 megahertz so they have more cores running faster in a smaller area at a lower voltage. That's giving you this about -- 1.77X performance increase. That's what GPUs provide and what the real big advantage is at 14-nanometer FinFET.

Q. And so what is your opinion about the relationship

between the 14-nanometer FinFET transistor and RAM?
A. So for -- all right. So this is my example. I have to explain RAM and GPUs.
So you think of RAM, next generation RAM is kind of like tires, okay? So if you have a faster interface you can grab to and from the things faster. But if you don't have those GPUs on top, lots of GPUs, then it's kind of like putting monster tires here, the RAM, on something without lots of GPUs, a Toyota Prius, instead of something that would actually take advantage of it.
What you really want to do is have lots and lots of GPUs to make with those really big tires. And that's the kind of vehicle, and that shows you the combination of why external RAM being the wheels and why you needs lots and lots of transistors to take advantage of it.
And if you do that, then you see those -- those really, really cool types of things that smartphones provide today.
Q. Thank you, Mr. Witt.
Do you have an opinion about the relationship between Qualcomm and its foundries?
A. Yes, I do.
Q. What is that opinion?
A. Qualcomm, because of their -- the volume that they provide, they're the largest smartphone manufacturer. And

their insight into -- into what they want smartphones to be, basically Qualcomm enable -- or has as contractors both Samsung and GlobalFoundries.

Q. Sorry, did you say smartphone manufacturer?

A. Sorry, I did.

Qualcomm enables or contracts the foundries, Samsung and GlobalFoundries, because of their ability to drive large number of -- of devices and their insight into smartphones.

Q. Have you reviewed any materials that reflect the relationship between Qualcomm and its foundries?

A. Yes, this is a master foundry agreement between Qualcomm and Samsung. This is PX-0809.

What this high-level agreement agrees is the processing characteristics of the transistor. Qualcomm, driving for what they want Samsung to be, and -- and Samsung agreeing to keep those parameters. This is actually a very important thing. We only do this for a very, very specific customers that can drive that kind of volume.

This is another one. This is actually from Qualcomm to GlobalFoundries. What this says, high level, if you read below about the 14LPP process, is they're going to copy exactly that 14LPP process developed at Samsung over in GlobalFoundries. This is Qualcomm contracting with GlobalFoundries.

The reason they do this is then they have a process here, a process here, they can go to either one of these fabs and get the most aggressive pricing. That's kind of what a contract -- contract is doing.

Q. And in the materials you reviewed, did you find any examples of the types of inter -- interactions that you just described?

A. Yes, this is PX-0044. In -- Dr. Kim, an engineer at -- or technical VP at Samsung, here he's talking about changing a threshold. So this is a -- a change to a high-volume process, that's something that's a fairly major thing. You don't just go off and do that unless the customer is important enough.

And what he's actually talking about here is changing the threshold. Major difference, the biggest difference is position of the threshold. So this is a change to the process flow that Qualcomm wants and that Samsung's providing.

The other side of that, this is Dr. Vadi, principal engineering manager at Qualcomm. And so here in the highlighted text, this is Dr. -- Dr. Vadi describing the kind of changes that they -- that they would ask from -- from their contract fabrication facilities.

For instance, changing the metal stack, which is kind of similar of what we saw at TI. Or changing of

threshold characteristics. Again, these are majors changes. You'd only want to do these for your best customers.

And this is the opposite of Qualcomm indicating what they want to see. And -- and Samsung providing on the other side.

Q. And, Mr. Witt, do you have an opinion about the 14 HP SOI process?

A. I do.

Q. What is the 14 HP SOI process?

A. The 14 HP SOI process is -- it's starting with the different starting material. This is silicon insulator instead of bulk CMOS. And then basically building a FinFET transistor on top of the SOI.

Q. And in terms of timeline, what -- was 14 HP SOI process a commercially viable alternative to bulk FinFET?

A. No, not at all.

This is a slide. I think Dr. Kuhn mentioned this, as well, but the 14-nanometer bulk FinFET was ready for production in 2014. Both Qualcomm and Samsung went into volume production in 2015/2016. The soonest that 14 HP SOI was available was 2017 Q3. So from a smartphone business, this is two or three years too late. This is a nonstarter.

Q. And so --

A. Go ahead.

Q. And so based -- I'm sorry.

And so based on all of the analysis that you've done in this in this case, what are your overall conclusions?

A. These are my overall conclusions, summarizing them here. 14-nanometer FinFET provides significant performance and power -- power benefits to the SoC. Summarized here. 14-nanometer FinFET SoCs improved the usage of RAM, as we saw, provides 77 better performance (sic) in graphics, from performance in power perspective.

Samsung and GlobalFoundries are acting as contractors for Qualcomm. And 14 HP SOI is not a viable alternative. It's several years too late. These guys wouldn't be in business anymore if they had to wait for it. Those are my conclusions.

Q. Thank you, Mr. Witt.

MS. WEN: Your Honor, I pass the witness.

THE COURT: Cross-examination by the Defendants.

MR. KENNERLY: Yes, Your Honor. Thank you.

May I approach, Your Honor?

THE COURT: You may.

MR. KENNERLY: Thank you, Your Honor.

THE COURT: All right. Counsel, proceed with your cross-examination.

MR. KENNERLY: Thank you, Your Honor.

May it please the Court.

CROSS-EXAMINATION

BY MR. KENNERLY:

Q. Good afternoon, Mr. Witt.

A. Good afternoon, sir.

Q. You discussed RAM just now. RAM relates to storage capacity, right?

A. That's true.

Q. And in general, the more RAM you have the more storage capacity you would have in a smartphone?

A. That's true.

Q. And would you agree that RAM is really important in a smartphone?

A. You need a certain fixed amount. Over that amount, you don't need more.

Q. Would you agree that consumers value RAM in making smartphones purchase decisions?

A. Flash, if they think of that as RAM, less so DRAM.

Q. You talked about RAM in your testimony so --

A. That's correct.

Q. And I apologize, sir, if you'll let me finish my question.

A. Sorry, go ahead.

Q. You spoke about RAM. And so my question at that level, would you agree that RAM storage capacity is important as a feature in a smartphone?

A. RAM is working space, not really storage capacity. Storage capacity is flash. That's permanent storage. RAM is working space. So a certain amount of RAM is very important, but once you get over working space, more doesn't really help.
Q. And would you agree that memory in the form of flash is very important in a smartphone?
A. Yes.
THE COURT: Mr. Kennerly, pull the microphone a little closer to you, please.
MR. KENNERLY: Yes, Your Honor.
Q. (By Mr. Kennerly) Would you agree that consumers value flash in making smartphone purchase decisions?
A. Yes.
Q. And generally, they would pay more for a smartphone that had more flash memory, right?
A. That is true.
Q. Now, you were asked by Plaintiff to assess the benefit of the 14-nanometer bulk FinFET transistors manufactured by Samsung and GlobalFoundries, right?
A. Can you repeat the question again? Sorry.
Q. Yes, sir. You were asked by Plaintiff in this case to assess the benefit of the 14-nanometer bulk FinFET transistors manufactured by Samsung and GlobalFoundries.
A. At the SoC level, yes.

Q. And what do you mean by that?
A. I don't -- I don't evaluate an individual transistor. My experience is that hundreds of millions to billions of transistors, and I never really did with individual transistors. So all my testimony has been what the value is of a billion transistors compared to the next best 20, 28-nanometer SoC.
Q. And, sir, you have a -- a binder in front of you with some documents. Your report is in there. You have a supplemental report, and I've included your deposition. If you'd look at your report, please, and that's at the first tab.
A. Okay.
Q. Paragraph 2, please.
A. Sure.
Q. And in Paragraph 2, you state, quote, I have been asked to assess the benefit of the 14-nanometer bulk FinFET transistors manufactured by Samsung and GlobalFoundries. You see that?
A. Transistors, plural. There's an S.
Q. Right. And I believe I included that in my question.
A. I interpreted it as single transistor. I probably just didn't hear it.
Q. Okay.
A. But it's easier if you say SoCs just because I know

that's many transistors.
Q. Well, what we have here is your report. And your opinion, you'd agree, in this case is set forth in your report, right?
A. That's correct.
Q. And in your report, you stated your assignment in this case, right?
A. Yes, I did.
Q. And is that a correct statement that I read into the record at Paragraph 2 of your report?
A. Yes.
Q. You rely on Dr. Kuhn's opinion that the incremental benefits of those 14-nanometer FinFETs are solely attributable to the '055 patent, right?
A. That's not true.
Q. Not true. You deny that?
A. I didn't rely on her. My thing -- my job was to assess the performance benefits of 14-nanometer at the SoC to 20/28-nanometer at the SoC. Mine was not to do the individual benefit of or ability of the transistor itself.
Q. So is your testimony that your opinion does not rely on Dr. Kuhn's opinion?
A. My testimony does not rely on Dr. Kuhn's opinion, yes, that's true.
Q. So -- strike that.

As you testified at the outset today, you didn't do any analysis of the '055 patent -- patent invention against the prior art, right?
A. That's true.
MR. KENNERLY: Mr. Dahm, may we pull up the demonstrative, please? And if we just have the -- the first -- I'm sorry, the -- the first list. And if we could just have the first line.
Q. (By Mr. Kennerly) Is this a fair representation of what you just testified to?
A. Oh, yes, that's true.
Q. Is it also correct that you didn't do any analysis to determine what the advance of the '055 patent is over the prior art?
A. That is true.
Q. You didn't evaluate or look at a single other patent than the '055 patent in terms of analyzing the benefits that are achieved from moving from 28-nanometer to 14-nanometer?
A. That's true.
Q. You also don't have any basis for an opinion as to the value of the incremental differences between the '055 patent and those patents that existed in the prior art, right?
A. That's true.
Q. You haven't done an analysis of the '055 patent against any bulk FinFET that may exist in the prior art, right?

A. That's true, sir.
MR. KENNERLY: You can have that one. Thank you.
Q. (By Mr. Kennerly) And you haven't considered the differences between the accused FinFET technology of the Defendants and any bulk FinFET in the prior art, right?
A. You're talking about the Defendants' patents; is that what you were asking?
Q. I'm speaking about the Defendants, so I said in my question the accused bulk FinFET technology of the Defendants -- I'll reask the question.
A. Okay. Sorry.
Q. You haven't considered the differences between the accused FinFET technology of the Defendants and any bulk FinFET in the prior art?
A. That's true.
Q. You didn't do any analysis to gauge the value of the differences between the accused FinFET technology of the Defendants and any bulk FinFET that's in the prior art?
A. That's true.
Q. And you haven't done any apportionment of any value of the benefits that may be attributed to the '055 patent versus any other patents that may have contributed to the shift from 28 nanometer to 14 nanometer?
A. That's true.
Q. Looking at the demonstrative, you'd agree you haven't

analyzed or considered any of the items listed here in forming your opinions?

A. I believe -- if all these are related to patents and prior art, I did nothing in -- in my report or in my deposition relative to prior art.

Q. The -- the characterization of your testimony, as stated here on this demonstrative, is that a fair characterization?

A. That's true. There's a "14n" at the end. You might want to make that "nm," but the rest of it seems fine.

Q. I believe we can probably fix that on the fly.

A. Okay.

MR. KENNERLY: Thanks, Mr. Dahm.

Q. (By Mr. Kennerly) While he's doing that, I will -- there you go. Do you see it?

A. Excellent.

Q. Are you good with that?

A. Yes.

Q. Thank you.

Now, as to whether benefits are solely attributable to the FinFET design, in your report you copied nearly verbatim certain language from Dr. Kuhn's report, correct?

A. No, that's not true.

Q. Would it help you to see a paragraph from your report versus hers?

A. Sure.

MR. KENNERLY: Mr. Dahm, can you pull that up, please?

MS. WEN: Your Honor, we object to this slide. You can't publish expert reports to the jury. That's hearsay.

THE COURT: What's your response, Mr. Kennerly?

MR. KENNERLY: Dr. Kuhn has testified, and I'm going to ask this witness questions about sentences in a paragraph of his report that is verbatim from Dr. Kuhn's report.

THE COURT: Well, you may certainly ask him questions about what he heard Dr. Kuhn testify to, but I don't see any basis upon which to publish his report or Dr. Kuhn's report to the jury. The reports are prepared by the experts so that each side knows the extent of the expert's opinions and where they will and won't testify. But they're not to take the place of the testimony of a live witness. So ask your questions.

MR. KENNERLY: Your Honor, if I may, my first area of inquiry is that he didn't write this -- this part of his report, and then I will ask him about this very opinion that's stated in this paragraph.

THE COURT: You can ask him about the preparation of his report and whether he did it or whether he had assistance, but as I think I've made clear, his report, as published to the jury, does not take the place of, nor

should it take the place of his live testimony. So ask him a question, and we'll get a live answer.

MR. KENNERLY: Okay.

Q. (By Mr. Kennerly) Sir, would you turn to Paragraph 207 of your report?

A. Sure.

Q. Are you there?

A. No. I would say I'm lost. Say 207?

Q. Paragraph 207. Oh, paragraph, I'm sorry --

A. Got it. Yes, I'm there.

Q. Thank you, sir.

Beginning at the second sentence, you state, quote: Transitioning from 28-nanometer or 20-nanometer to 14-nanometer FinFET designs provided two benefits: (a) the benefit of node shrinkage; (b) the intrinsic benefit of the FinFET transistor design over planar. Both of these benefits are as a practical matter the sole result of the FinFET.

Do you see that?

A. Yes.

Q. As to what you say there in your opinion, is the intrinsic benefit of the FinFET design over planar. You agree that prior art FinFET designs also have that intrinsic benefit, right?

A. Can you restate the question, please?

Q. As -- as stated in Paragraph 207, I'm referring to what you say is the intrinsic benefit of the FinFET design. Do you see that?

It's --

A. Yes, I see it.

Q. And as to what you say is the intrinsic benefit of the FinFET design over planar, you agree that prior art FinFET designs also had that same intrinsic benefit?

A. If you're asking was the 14-nanometer FinFET fundamental to moving under 20 nanometers, which I think is what this statement is, then absolutely. I'm -- I'm getting lost in what's the substatement that you're trying to make after that.

MR. KENNERLY: Objection, nonresponsive.

THE COURT: I'll strike the portion of "I'm getting lost in what's the substatement you're trying to make." The remainder of the answer, though, is responsive, and I'll overrule the objection as to that portion.

Let's move along, counsel.

Q. (By Mr. Kennerly) Let me ask you the question, Mr. Witt, you refer to here to the intrinsic benefit of the FinFET transistor design over planar. Do you see that?

A. Yes.

Q. What you say is the intrinsic benefit of the FinFET design over planar, I'm not asking you to agree me, but that

intrinsic benefit is also present in prior art FinFET designs?
A. No, I -- I don't believe that. Prior art FinFET designs?
Q. Yes, sir.
A. If -- if FinFET designs have not been reduced to practice, and I'm not aware of any that were reduced to practice, then -- then -- then they have no attributable benefit.
Q. So a -- a FinFET design that's in the prior art, your testimony is that it has no benefit over a planar design?
A. Even if it was not reduced to practice, then it -- it was never a transistor, and I certainly couldn't have evaluated it in the transistors that the 14-nanometer FinFETs are here.
Q. So your -- your qualification is that your -- your statement here in this paragraph, though not stated, is about a FinFET design that has been reduced to practice versus something that hasn't?
A. Yes. All the questions you said before were all about prior art, and I absolutely agree, I did not look at prior art. But I did look at devices that were in production.
Q. You'd agree -- I'm sorry, did you finish?
A. I'm finished.
Q. You agree with me that in Paragraph 207 you didn't make

this qualification about reduction to practice?

THE COURT: You're going to have to speak up, Mr. Kennerly.

Q. (By Mr. Kennerly) Did you hear me, sir?

A. Is it all right if I reread 207 since you're --

Q. Please?

A. Okay. Thanks. Hold on.

Yes, all we're talking about here is the transition from 28 to 20 to 14-nanometer FinFET. That's what the statement of 207 does. And it's saying that all the benefits there can be due to 14-nanometer FinFET. Because it will defend and enable the transition. There's nothing there about prior art, but that is talking about practically devices moving from 28 planar to 20 planar to 14-nanometer FinFET. That's what this statement is about, speed and energy efficiency.

Q. I understand your testimony today, sir.

With respect, your report expressing your opinion says 14-nanometer FinFET design. And so I'm asking you about the design, and that's the nature of my question. So I'm not asking about reduction to practice or anything else.

Your statement here, your opinion expressed here is there is an intrinsic benefit of the design of the FinFET, right?

THE COURT: Counsel, approach the bench.

(Bench conference.)

THE COURT: You're not going to argue with the witness, Mr. Kennerly. Ask him questions. If he gives you an answer that's contradicted by his report, then you may seek leave to publish that portion of the report to impeach him. But ask him questions, get answers, don't argue with him. All right?

MR. KENNERLY: Understood, Your Honor.

THE COURT: All right. Let's proceed.

MR. SHEASBY: Thank you, Your Honor.

(Bench conference concluded.)

THE COURT: Let's proceed, please.

Q. (By Mr. Kennerly) Let's talk about the other stated benefit you referred to there, which is node shrinkage. Do you see that?

A. Yes, I do.

Q. And as to the benefit of node shrinkage you relied on deposition testimony from a GlobalFoundries witness, Dr. Samavedam. To the effect that shrinking the size provides most of the performance and energy benefits, right?

A. Yes, I see in Paragraph 208.

Q. And he testified that at least some of the performance and energy benefits come from other device improvements like contact resistance, oxide scaling, et cetera, agreed?

A. Yes, I see it there.

Q. And you would agree that those other device improvements are distinct from the benefit of node shrinkage and distinct from the intrinsic benefit of the FinFET design?
A. Before 20 nanometers, sure.
Q. The testimony on which you rely is not limited to before 20 nanometers, agree?
A. For Dr. Samavedam, I believe that's true. But I'd have to see -- read his entire deposition slowly again.
Q. Well, you certainly read it before preparing your report, correct?
A. Yes, that's true.
Q. And am I correct that you assumed no contribution from those other device improvements in coming up with your estimated performance and power benefits in this case?
A. It's -- again, there would not be a 14-nanometer node, so it was the invention that made them move to 14, so -- and 20 nanometer clearly was not a -- a good node. So it was what enabled you to move down to 14 nanometers.
Q. And so the answer to my question is, no, you assume no contribution from that, right?
A. There would not have been a node without the FinFET.

THE COURT: Gentlemen, what do I need to do to get you to speak up. This is a big room. There are a lot of people. You're mumbling. Speak up. You have microphones. I'm tired of having to remind you of this.

MR. KENNERLY: Yes, Your Honor.
THE COURT: Let's continue.
MR. KENNERLY: Yes, Your Honor.
THE COURT: We're wasting everyone's time if the jury can't hear what you're asking and what you're answering.
Q. (By Mr. Kennerly) Sir, you assume no contribution from those other device improvements, right?
A. That's true.
Q. Now, your estimated performance and power benefits for Samsung's Exynos chips and Qualcomm's Snapdragon chips are different, right?
A. Yes.
Q. And at least for power consumption, you estimate a much bigger improvement, almost double, for Qualcomm's Snapdragon versus Samsung's Exynos, right?
A. Are you talking about CPU or battery or GPU specifically?
Q. Since you have your report in front of you, if you'll look at the prior paragraph, it's 206?
A. Okay.
Q. And I'm referring to power consumption or power as stated in your -- your table there. So comparing Exynos and Snapdragon, you'd agree with me that Snapdragon is about double?

A. For -- for battery life benefit, correct.
Q. Okay. And you'd agree that both Exynos and Snapdragon contain the same size 14-nanometer FinFETs, right?
A. Correct.
Q. And would you agree that the designs of Samsung's Exynos chips and Qualcomm's Snapdragon chips are not identical?
A. They're not identical.
Q. And would you agree that where those designs are not identical, where they differ, they differ in ways that are not solely attributable to the '055 patent?
A. Could you repeat the question, please?
Q. Where the designs differ between the Exynos and Snapdragon chips, would you agree that they differ in ways that are not solely attributable to the patent?
A. Relative to the 14-nanometer Exynos and Snapdragon devices?
Q. Yes, relative to each other, those differences, you'd agree, are not attributable to the patent?
A. They used the transistors in different ways. The transistors are attributable to the patent. So they use different circuits, and they use different number transistors of circuits, so -- but underlying it, it's still the same transistor.
Q. The -- the numbers that you state in your chart, those differences are not solely attributable to the patent,

right?
A. One of the parts is 20 nanometers, and the other part is 28 nanometers. That's probably the biggest difference comparing to 14 nanometers is -- is the previous planar SoC.
Q. You heard Dr. Kuhn's testimony about Hafnium oxide, right?
A. I did.
Q. You agree that use of the additional Hafnium oxide layer was important to the ability to scale down to 14 nanometers?
A. It's really not my expertise.
Q. You don't have any reason to disagree with Dr. Kuhn's testimony?
A. No, she's a -- a perfect expert for that.
Q. Are you able to agree that you couldn't have gotten to 14 nanometers without Hafnium oxide?
A. I'm not the person to ask that, truly.
Q. Would you agree that if the products could not have gotten down to 14 nanometers, there would have been no value, right?
A. The smartphone business would have come to a halt.
MR. KENNERLY: That's all I have, Your Honor. Pass the witness.
THE COURT: Redirect, Ms. Wen?
MS. WEN: Yes.

REDIRECT EXAMINATION

BY MS. WEN:
Q. Do you recall when you talked to opposing counsel about reduction to practice?
A. Yes.
Q. What did you mean by reduction to practice?
A. That the only devices that I could look at were devices that had actually, you know, gone as far as -- as being built as devices and put in the phones. So I wasn't able to look at anything that wasn't a real large device that had gone through production.
Q. And do you recall when opposing counsel asked you about whether you analyzed the claims of the '055 -- I'm sorry, whether you analyzed prior art?
A. Yes.
Q. Why didn't you do that analysis?
A. If there had been any prior art in 14-nanometer FinFET or any type of FinFET device that had gone in production -- you know, people would have used it. I believe all the previous attempts at it were -- were not successful. So that's why I didn't -- you know, if -- if 14 nanometer -- if FinFETs had worked, we would have seen them in SoCs, and the only ones we saw were relative to the '055 patent.
Q. And do you know if the 20-nanometer node used Hafnium oxide?
A. Only from Dr. Kuhn's testimony this morning.

Q. And do you know if the 20-nanometer node used High-k metal gates?
A. Only from Dr. Kuhn's testimony this morning.
MS. WEN: That's all, Your Honor. I pass the witness.
THE COURT: Is there further cross-examination?
MR. KENNERLY: No, Your Honor.
THE COURT: All right. You may step down, Mr. Witt.
THE WITNESS: Thank you.
THE COURT: Ladies and gentlemen, we're going to take another brief recess.
You may close your notebooks and leave them in your chairs. Follow all my other instructions, and we'll be back in here shortly to continue. The jury is excused for recess.
COURT SECURITY OFFICER: Rise for the jury.
(Jury out.)
THE COURT: Be seated, please.
Mr. Sheasby, who does Plaintiff intend to call next?
MR. BUNT: Your Honor, we're going to call Roy -- Mr. Roy Weinstein.
THE COURT: All right. Do you have deposition witnesses to call?

MR. BUNT: We do have some deposition --

THE COURT: They will follow Mr. -- Dr. Weinstein?

MR. BUNT: Mr. Weinstein, yes, sir. Yes, Your Honor.

THE COURT: All right. What's your best estimate as to your direct examination of your damages expert?

MR. BUNT: About an hour and 10 minutes.

THE COURT: All right. Thank you for that information.

We stand in recess.

(Recess.)

COURT SECURITY OFFICER: All rise.

THE COURT: Be seated, please.

All right. Plaintiffs, are you prepared to call your next witness?

MR. BUNT: Yes, Your Honor. We're going to call Mr. Roy Weinstein.

THE COURT: All right. Let's bring in the jury, please, Mr. Elliott.

COURT SECURITY OFFICER: All rise for the jury.

(Jury in.)

THE COURT: Plaintiff, call your next witness.

MR. BUNT: Thank you, Your Honor. Plaintiff calls Mr. Roy Weinstein.

THE COURT: If you'll come forward and be sworn,

please, Mr. Weinstein.

(Witness sworn.)

THE COURT: Please have a seat, sir. Mr. Bunt, you may proceed with your direct examination of the witness.

MR. BUNT: Thank you, Your Honor.

ROY WEINSTEIN, PLAINTIFF'S WITNESS, SWORN

DIRECT EXAMINATION

BY MR. BUNT:

Q. Mr. Weinstein, can you please state your full name for the jury?

A. Roy Weinstein.

Q. And can you tell the jury a little bit about yourself?

A. My name is Roy Weinstein. I live in Los Angeles, California. I'm married with two grown children. I'm an economist and a managing director at an economic research and consulting firm known as Micronomics.

Q. And why are you here today?

A. I'm here today to talk about a fair amount that should be paid by the Defendants to KAIST for use of its patented technology.

Q. And, Mr. Weinstein, we're going to go through your analysis in detail in just a moment. But can you first provide the jury with your conclusions?

A. Yes, sir. I have concluded that damages adequate to

compensate for infringement for the period November 29th, 2016, through May 14th, 2018, are $321,438,451.00 for Samsung; $296,851,609.00 for Qualcomm; and $98,541,744.00 for GlobalFoundries.

Q. Is this a slide that you've prepared for us?

A. Yes, sir, it is.

Q. And have you prepared other slides to assist the jury with your testimony?

A. I have.

Q. What is it that you do that enables you to come up with these figures?

A. Well, I'm an economist by training. I have academic training in economics and accounting, economic theory, statistics, and econometrics. I try and stay current with academic and professional literature. I'm a member of professional associations that like economists like myself tend to join.

And what I do as an economist is study questions such as how prices are determined. Economists also look at things like interest rates and employment and the economy, although I personally don't do too much of that. But I also use complex models to understand and measure various economic relationships and inter -- interrelationships.

Q. Mr. Weinstein, is your firm being compensated for the work you've done on this case?

A. Yes, sir, it is. My firm, Microeconomics, receives $750.00 per hour for my time.
Q. And do you believe that the Defendants' experts are being compensated for their time?
A. I do.
Q. And is your compensation independent of the outcome of this litigation?
A. No, sir, it isn't in any way.
Q. It is dependent or is not?
A. No. My composition or my firm's compensation is in no way dependent on how this litigation winds up.
Q. Can you tell the jury about your educational background?
A. Yes. I received a Bachelor of Business Administration degree with honors in economics from City College New York back in 1964, and a Master of Arts degree, also in economics, from the University of Chicago in 1967.
Q. Did you receive any honors and awards in connection with your education?
A. I did. At City College, I received a couple of awards for academic performance, and at graduate school, University of Chicago, I received fellowships from the Walgreen Foundation and the U.S. Public Health Service.
Q. And have you been honored since leaving school for your work as a professional economist?
A. Yes, sir, I have. I received one award from the

Business and Economics Alumni Society at City College back in 2008 or 2005. It was called the Career Achievement Award, and I'm the first recipient of that award.
Q. And can you briefly summarize your professional experience for the jury?
A. Yes. I've been engaged in economic research and consulting continuously since leaving school. I've published articles dealing with the -- the calculation of damages in patent infringement cases that was published by the Journal of the Patent and Trademark Office Society or the PTO. Another article published by the Federal Circuit Bar Journal, also dealing with the calculation of patent damages. I've been invited frequently to speak at various public forums or seminars, again, on the calculation of patent damages. And I'm a member of professional associations, as I indicated, the American Economic Association, and also the Dean's Council at my alma mater.
Q. Can you identify some of the consulting clients that you've had over the course of your career?
A. Yes. So over the years I've had a number of fairly well-known names as clients, Adidas and Dell and Intel, National Basketball Association, Halliburton, Ericsson, lots of others. And I've also had a fair number of clients that I had never heard of until the engagement. So over the years, I've been fortunate to have an interesting -- an

interesting group of clients.

Q. What sort of assignments have you been asked to undertake as an economist during your career?

A. Well, as with the interesting set of clients, I've had interesting assignments. I've been asked to calculate the value of oil rights off the City of Long Beach in California. I was asked to do that by the City of Long Beach in the state of California. I've done a number of economic impact studies, economic impact of the Rose Bowl and the Tournament of Roses Parade on -- on -- Pasadena and Los Angeles, also economic impact studies on the Oscars and the Emmys, and most recently, the National Basketball Association All Star game which was held in Los Angeles. And I -- I do those studies because the communities are interested in knowing something about the impact that those studies have on -- on the local environment, both businesses and -- and residential areas and traffic and things of that sort.

And, obviously, I also have done quite a bit of work involving the calculation of patent damages in numerous different context.

MR. BUNT: Your Honor, at this point, we'd like to offer Mr. Roy Weinstein as an expert on the valuation of intellectual property and the calculation of patent damages.

THE COURT: Is there objection?

MR. KENNERLY: No objection.

THE COURT: Then the Court will recognize the witness as an expert in those designated fields.

Continue, counsel.

MR. BUNT: Thank you, Your Honor.

Q. (By Mr. Bunt) Mr. Weinstein, can you tell the jury what materials you considered in reaching your conclusions in this case?

A. Yes, sir. I had access to materials that were made available to me both from KAIST and the Defendants, as well as materials that I gathered on my own. I looked at the patent-in-suit. I had a chance to look at deposition testimony from many of the individuals involved in this case. I had access to quite a bit of internal information from the Defendants, internal presentations, internal correspondence, marking materials, license agreements, quite a bit of their sales and financial information over time.

And then in the right-hand column of this slide, there's information, most of which I gathered on my own at Micronomics, information on mobile device pricing and various specifications associated with mobile devices. We collected industry analyst reports, trade press. There's academic literature that I review from time to time. And then I had access to other expert reports in this case.

Q. Can you provide the jury with your understanding of why

patent rights are important in the United States?
A. Yes. Patent rights are important because they are designed to encourage innovation. The idea behind patent rights is that they give the patentholder the -- the right to exclude others from using an invention. And by so doing, the concept is that individuals and entities will be encouraged to innovate and develop new inventions. And they are protected by the patent system in that if anyone else wants to use those inventions, they need permission from the patentholder. And so it's from that that the concept of -- of patent rights has evolved.
Q. Is there a name for agreements that are reached between patentholders and the entities that wish to have access to those patents?
A. Yes, sir, there is. Those agreements are called license agreements. And license agreements are entered into by the patentholder, which typically is known as the licensor, and the entity which wants permission to use the patent, and that entity is known as the licensee.
Q. And how do these license agreements come into existence?
A. They come into existence through negotiations between the patentholder and the licensee. In other words, the two entities sit down and negotiate fair payment for permission to use the invention.
Q. And in this case, how did you go about determining what

constitutes fair compensation to KAIST for use of the patent-in-suit?

A. Well, I began with a patent statute. And this is a U.S. Government patent statute. And it says that the claimant, that's -- that's the patentholder, should receive damages adequate to compensate for infringement but in no event less than a reasonable royalty for use of the invention made by the infringer. And so that's the starting point. The starting point is that damages should be sufficient to compensate for infringement but not less than a reasonable royalty.

Q. And then how do you go about determining damages adequate to compensate for infringement?

A. What you do in order to -- to answer that question is you put the entities together. And you have them conduct what's called a hypothetical negotiation between the patentholder and the parties that are accused of infringement.

So in this case, in this -- in this slide, I depict a negotiation. It's called a hypothetical negotiation because it didn't actually happen. But we put them back together in January of 2015 because that's the first date of -- of alleged infringement in this case. And we say to them negotiate for rights to use the '055 patent. Negotiate for permission to use the patent before infringement occurs.

And it's called a hypothetical negotiation because it didn't actually occur. But that's how we get to the answer of what damages should be adequate to compensate for infringement.

Q. And why did you use this idea of a hypothetical negotiation?

A. In my experience, it's used in virtually every patent damage case that I've -- I've ever been aware of. And I've been doing patent damages work now since the late 1980s. But in every situation, this hypothetical negotiation framework is the one that in my experience both the Plaintiff and the Defendant use to resolve the question of what fair payment would be.

Q. Now, in the slide that you prepared, you have listed P&IB on the left-hand side as the licensor. Doesn't the patent belong to -- to KAIST IP US?

A. Yes, it does. My understanding is that the patent was transferred by P&IB to KAIST US some time in 2016.

But in 2015, at the time of the hypothetical negotiation, P&IB had the patent, and so P&IB would be sitting at this negotiating table.

Q. The damages that you have calculated are owed to KAIST IP US not P&IB; is that right?

A. Yes, sir.

Q. Are there certain assumptions that are necessary for purposes of this hypothetical negotiation?

A. Yes, sir, there are.
Q. And can you talk us through those?
A. Yes. The hypothetical negotiation framework carries with it a series of assumptions that are always attached to it. And so the assumptions for this hypothetical negotiation that the parties on both sides of the table agree to and have in mind are that the patent is valid, it's infringed, and it's enforceable. There isn't any question or any debate or any discussion about those concepts. They're agreed to by the parties.
In addition, the parties at the hypothetical negotiation table, they have to reach an agreement. They have to get to the finish line, unlike a real-world negotiation where one side or both sides can get up and walk away. Here we have to get to an answer.
Q. Are there any other assumptions that make a hypothetical negotiation different from a real-world negotiation?
A. Yes, sir, and that's -- that's No. 3 on this slide. And that's a -- as with the others, it's a very important assumption.
The parties at the negotiating table in this hypothetical negotiation are actually aware of information about the future importance of the patent. In a real-world negotiation, you may have some estimate or some expectation or some hope or some forecast about the importance of a

particular technology.

At the hypothetical negotiation, they actually know how important the technology is. In other words, they have access in a sense to information about the future, to the future sales, the future profits associated with using the technology. And that is part of the framework of assumptions for the hypothetical negotiation. And obviously, that's very, very different from a real-world negotiation.

Q. Is there any other information available in a hypothetical negotiation that's not necessarily available in a real-world negotiation?

A. Well, yes, to be clear, in the hypothetical negotiation, the entities sitting on both sides of the table, they know something about future sales and future profits associated with the technology.

Q. And would the folks in this hypothetical negotiation be aware of the calculations of performance, battery -- battery life, and cost improvements that we've been talking about in this case?

A. Yes, sir, they would, they would be aware of the contributions of -- of the patent, of the '055 patent, as described by Mr. Witt and Dr. Kuhn.

Q. Aside from the assumptions made as a part of the hypothetical negotiation, is there anything -- anything else

that you relied on in forming your opinions for this case?
A. Yes, sir. There -- there's one more thing, which is part of this hypothetical negotiation framework. And that's called the Georgia-Pacific factors.
The Georgia-Pacific factors can be thought of as a checklist of 15 items that the entities sitting at the hypothetical negotiation table would have in mind as they negotiate over rights for the patent.
They don't have to use all these items, but it's a handy checklist to run down as they go through the negotiation. And so the Georgia-Pacific factors, in my experience, are always part of this hypothetical negotiation framework.
Q. So you discussed the Georgia-Pacific factors, the patent law statute, and the hypothetical negotiation used -- that you use in this case. Are -- are those all used by the Defendants' damage expert in this case, as well?
A. Yes, sir.
Q. Okay. And did you consider all 15 of these Georgia-Pacific factors in developing your reasonable royalty?
A. I -- I consider all 15, as is always the case. Some are more important than others, but I think about all 15 because they're on the checklist.
Q. How did you analyze the hypothetical negotiation here?

A. Well, with that Georgia-Pacific checklist, I usually start with Georgia-Pacific Factor 1, which has to do with basically prior licenses, and I will come back to that. That's the place that I usually begin.

But in this case, on given what I've learned about the importance and the contributions made by the patents, I'm beginning today with a discussion of Georgia-Pacific Factors 9 and 10. They are two different factors, but they're really very similar in the sense that they address the contributions associated with the invention.

Q. And what were the benefits associated with the patented invention?

A. We've heard about three separate benefits. Those include increased speed, increased power efficiency, and significant cost savings. And those are the three benefits.

Q. Do those three benefits overlap?

A. No, sir. They're -- they're separate.

Q. And have you seen information regarding the speed and power efficiency benefits provided by the patent-in-suit?

A. Yes, sir, I have. This slide is a 2017 Samsung document. And I abstracted out from a page inside the document which identifies power efficiency benefits associated with longer battery life and in -- enhanced performance associated with speed. And these are both in connection with the -- the 14-nanometer FinFET technology.

Q. And what exhibit number is that for the jury's benefit?
A. That's Exhibit 1170.
Q. Have you seen any information quantifying the speed and power efficiency benefits provided by the accused FinFET technology?
A. Yes, sir, I've seen -- I've seen several sources of such information. This next slide, which is Plaintiff's Exhibit 134, is -- is a 2017 Samsung document. And in it, it talks about Samsung's 14-nanometer FinFET processing offering. And toward the bottom, it talks about 14LPE, which I believe stands for low power -- low power early, offers 40 percent faster performance, 60 percent less power consumption, and 50 percent smaller chip scaling area as compared to the 28LPP, which I understand means low power plus predecessor technology.
Q. And is that Plaintiff's Exhibit No. 134?
A. It is, sir.
Q. Now, have you seen similar information for GlobalFoundries?
A. I have. So this document, which is Plaintiff's Exhibit 849, again, talks about 14LPP FinFET. You can see it's a 2016 GlobalFoundries document. And it shows an arrow for device performance, an increase of 55 percent. And the power is a little bit covered up by the -- by the arrow on the right. But it shows improvement of 60 percent between

28 nanometer and 14.
Q. Mr. Weinstein, have you seen any documents that suggest these benefits were important to the Defendants?
A. Yes, sir, I have.
Q. What do we see in this slide?
A. This next slide is a 2015 Fortune Magazine article, and it refers back to a survey that was conducted over the new year at a convention in Las Vegas. And it talks about -- the question that's asked is: What new or improved smartphone features are you most excited about?

Improved battery life was the leading answer with a third of the respondents identifying that as the most important feature -- most improved feature. And faster processors came in second with 16 percent. So these are features that are very important to consumers of smartphones.
Q. And is that PX-1204?
A. It is, sir.
Q. And are there any other documents showing the importance of battery life and speed?
A. Yes. This is another -- another article. Consumers -- ConsumerScape is -- it's a survey entity, it's part of IDC. IDC is sort of the gold standard data -- data group for semiconductor industry and telecommunications.

And so this is a June '14 -- 2014 survey result,

and it talks about what drives smartphone purchases. And in the middle, it says: At the very top of the list of purchase drivers is battery life.

There's a typo there, but it's battery life.

And at the bottom it says -- it indicates that battery life is also the most important driver of smartphone purchase in any region of the country across operating systems and brands, et cetera.

So my take from this is that battery life helps drive demand for smartphone products.

Q. And is this Plaintiff's Exhibit 929?

A. It is, sir.

Q. So did you actually measure the dollar value of benefits provided by the '055 patent?

A. I did.

Q. And how did you do that?

A. Well, I began by looking at two of the benefits that we've heard about, increased speed and increased power efficiency. So that's where I -- that's where I start. And, subsequently, I'll talk about significant cost savings, as well.

Q. Okay. So did you examine the effects that these increases in speed and power efficiency would provide -- that were provided by the patent-in-suit?

A. I did, and I used the technique that's available to me

as an economist in order to do that.
Q. And what was that?
A. That technique is known as regression analysis.
Q. Okay. What is a regression analysis?
A. Well, regression analysis is a statistical or econometric tool that's used by economists and statisticians and financial analysts to separate out the impact of individual variables, individual components in a way that holds other things that could be affecting -- affecting outcomes. It holds those other things constant.
Q. What did you use regression analysis to calculate in this case?
A. In this case, I used regression analysis to actually determine the contribution made by increased speed and power efficiency to smartphone and tablet prices. In other words, I used regression analysis to isolate the incremental or additional benefits associated with increased speed and power efficiency on smartphone and tablet prices, holding all of those other inputs constant, all the other kinds of things that may impact smartphone and tablet prices.
Q. And can you provide the jury with an example of how regression analysis works?
A. Well, this is a very simple example. You have on the slide depictions of two cars that are identical in every respect, except one has an automatic transmission and the

other has a manual transmission. It's the left and the right, respectively.

And the difference in price is about a thousand dollars. And since everything else about the cars is identical, what one can say is having an automatic transmission on a car adds a thousand dollars to the price. Despite the fact that the cars themselves are very complicated products and they have all kinds of other components, given that we're saying that everything else is held constant, you can actually isolate the incremental or additional value to the price associated with an automatic transmission.

And this is an example of what regression analysis allows you to do. It allows you to compare two complicated products but hold a lot of things constant so that you can isolate the importance of some individual component.

Q. And was the regression analysis that you ran as simple as this one?

A. No, it wasn't.

Q. So how did you go about conducting the regression analysis to analyze speed and power benefits?

A. Yeah. The reason that my regression analysis isn't as simple as that is that with respect to the devices, such as smartphones, you have literally hundreds of components, if not more. And they can all be different. And so it becomes

very difficult to hold everything else constant.

So in order to do my regression analysis, what I did is, is as follows. We purchased a -- a huge amount of information from an entity known as Strategy Analytics which collects this information and sells it to people like me who are interested in it. And we gathered up information on -- on smartphone and tablet prices for a five-year period, January 2013 to December of 2017.

And in -- in that data that we bought, we had information on retail prices of smartphones. Ultimately, we wound up with 43,000 observations over this five-year period for basically all of the smartphone manufacturers.

We also had information on -- on specifications associated with these products, such as processing speed and battery capacity. And then a series of variables which I call control variables, which going into the regression analysis, it seemed to me I would want to include as things that I'd want to hold constant because I felt they might have an important effect on the price.

So in deciding what to -- what to include in the regression analysis, I really had two things in mind at the outset.

One is what facts in this case are we interested in knowing about? And we're interested in knowing about the importance of speed and battery capacity. And so they had

to be in the regression analysis.

And then the -- the rest is what else might be important enough in connection with this investigation to include in the study? And so for No. 4, I have a summary of the other variables that I included.

So I had a separate variable for the operating system. Was it Apple or Android or a BlackBerry system or something else?

For the manufacturer, was it an Apple phone or a Google phone or somebody else's phone?

For the retailer, was it purchased at Walmart or from Amazon Online, or from some other type of store? I have a variable for time which since I have a five-year period, I want to adjust for the fact that maybe phone prices are changing over time. Five years is a long time. So I include that. And the price variable is -- that's the launch price. That is when the phone first -- first went out, what was the launch price? And then some other things relating to screen size and camera size, et cetera.

Q. How do the dollar benefits associated with the speed and power benefits affect the Defendants?

A. Well, they -- they affect the Defendants because other things equal, if -- if processing speed and improved battery life have -- have an impact on the final price of the phone, the Defendants benefit from that. If -- if other things

equal, if the price of smartphones and tablets goes up as a consequence of improvements in speed and battery capacity, then that works its way back to the Defendants.
Q. Did you prepare regression analyses both for tablets and for smartphones?
A. I did.
Q. And did you consider the same factors in connection with each of those two regressions?
A. I didn't consider exactly the same factors in connection with each. I had most of the same factors. But there are some differences in the way in which tablets are used and the way in which phones are used. Tablets are sometimes used for multitasking in ways that phones aren't, and so I tried to take account of that by including slightly different variables in some cases in the tablet regression, for the phone regression.
Q. Have you seen any evidence that speed and power efficiency benefits are important factors affecting smartphone demand?
A. Yes, sir. I think we've seen some of those, but this is a 2017 survey by an entity known as Statista, which is an entity that collects voluminous information in all kinds of industries -- just collects it and then sells it to people who are interested in having it. This is PX-1077.
And this survey indicates that with respect to

which properties users find particularly important for their smartphone, 82 percent answered long battery time, 61 percent talked about a fast processor. So speed and battery life clearly are important to smartphone consumers.

Q. So what were your regression findings?

A. This slide contains a summary of the findings. With respect to smartphones, what I found is that a 1 percent increase in speed leads to a $1.06 increase in the retail price of smartphones, holding other things constant. All right?

With respect to tablets, a 1 percent increase in speed leads to a price increase of 92 cents, holding other things constant. The other things that I'm talking about are such as identified on the previous slide.

And, finally, with respect to SoCs not sold in phones, I apportioned that down to the chip level. And there, a 1 percent increase in speed leads to a price increase of about 18 cents.

Q. What do these price increases represent to the Defendants?

A. They represent additional benefits that the -- benefits that the Defendants receive as a result of these improvements in speed and battery life.

Q. And would these represent profits for the Defendants?

A. They would. The reason they'd represent profits is

that, as we've heard, the technology taught by the '055 patent does not bring about cost increases. In fact, it brings about cost savings. So these benefits represent net -- net profits to the Defendants.

Q. What was the next step in your analysis?

A. Well, next, I took into account the conclusions of Mr. Witt on the actual benefits that he found associated with using 14-nanometer chips prior to the previous technology. And this is a summary of the findings that he just presented here in his testimony.

And what I used is a -- are the figures at the bottom, and those are either averages or conservative numbers of the actual figures that he just presented.

So for speed, I -- I used a 20-percent improvement with respect to Exynos and Snapdragon chips and a 12-percent benefit with respect to power efficiency converted to speed as described by Mr. Witt. And for Exynos chips, I used 12 percent, Snapdragon chips I used 22 percent.

So these figures come from -- from Mr. Witt.

Q. Based on these regression results, can you provide an example of how you determined Defendants' incremental profits due to the speed and battery life benefits provided by the patent?

A. Yes, sir. So this is an example with respect to the Galaxy S7 smartphone. That's one of -- one of Samsung's --

Samsung's big sellers.

And, again, for the period November 29th, 2016, to May 18th, 2018, according to Mr. Witt, the benefits are 20 percent for speed, 12 percent for power efficiency converted to speed. And that comes from the last exhibit that we just looked at which came from Mr. Witt.

So the combined total of those is 32 percent because those two benefits are separate.

So what I do next is I take the regression results, which I obtained of the increased profit associated with a 1-percent increase in speed, and I multiply that times the benefits as calculated by Mr. Witt. And when you do, that the total increase in profit in this example with respect to the Galaxy phone is 33.92.

Q. And is that total per year unit increase for each Galaxy S7 phone that uses an Exynos processor?

A. Yes, sir.

Q. Sir, how did you calculate the total incremental speed and profits for the rest of Samsung's products?

A. I -- I used the same method. So that was an example. I go through the same method. I take my regression results and apply to them the speed and power efficiency benefits that were described by Mr. Witt. And I do that for each of the accused Samsung products.

And this slide depicts those products. You have

phones and tablets with Exynos chips, phones and tablets with Snapdragon chips, Exynos chips sold alone, and then the sum of those -- those three.
Q. And so at the bottom, the total incremental profits for Samsung created by the '055 patent infringement would be how much?
A. $1,860,232,783.00.
Q. And then what about for Qualcomm, how did you do your analysis there?
A. I did the same thing for Qualcomm, except here -- so it's the same approach, and the total for Qualcomm is $2,470,571,452.00. Those are the incremental profits.
Q. And did you use the same regression analysis to calculate benefits realized by GlobalFoundries from use of the '055 patent?
A. No, sir, I did not. GlobalFoundries, my analysis is limited to the cost savings since GlobalFoundries is a foundry, it's a manufacturer. And so with respect to GlobalFoundries, I calculated damages using cost savings, not the regression analysis.
Q. Well, have you seen any information suggesting that the Defendants realized cost savings in producing the infringing products?
A. Yes, sir, I have. This -- this slide, which is PX-849, depicts a -- it's a GlobalFoundries document, and it depicts

a comparison between 28-nanometer and 14-nanometer chips, the 28 nanometer is on the left and 14 nanometer is on the right.

Q. And then at the bottom of that, the bottom portion that's highlighted says estimated die cost, and then it has 1 beside -- or 128 nanometers and .75 under 14 nanometers. What does that mean?

A. Well, what that means is there's a 25 percent savings in die cost when you move from 28 nanometers to 14 nanometers. And you can see that between -- by comparing the 1 and the 0.75. That's a 25-percent difference, and that's the savings associated with moving from 28 nanometers to 14 nanometers.

Q. Did you see any testimony from the Defendants concerning cost savings?

A. Yes, sir, I did. This is from Mr. Samavedam at GlobalFoundries, and his testimony on this slide is consistent with the last document that we just saw; namely, he depicts an estimated die cost savings of 25 percent in moving to 14-nanometer production.

Q. And would these cost savings apply to Samsung, as well?

A. Yes, my understanding is that they would.

Q. So what factors other than Georgia-Pacific Factors 9 and 10, did you consider in your analysis?

A. Right. So we just finished my analysis of

Georgia-Pacific Factors 9 and 10. And as I said, I ordinarily thought with Georgia-Pacific Factor 1, but I thought today I would start today talking about 9 and 10 given the benefits.

So the next one that I considered is Georgia-Pacific Factor 1, which pertains to rates received by the patentholder for licensing the patent-in-suit. And that's -- that's one of the factors that one looks at.

Q. Did you find that there was any actual evidence of prices paid for the patent-in-suit?

A. Yes, sir, I did.

Q. And what was that?

A. There's a license we've heard something about between P&IB on the one hand and Intel on the other in the U.S. in 2012. And there's also a license between KAIST and Intel for the Korean counterpart of the '055 patent at the same time.

Q. And can you tell us a little bit more about those two agreements?

A. Yes, those -- those two agreements included payment by Intel to P&IB in the United States for -- of $6.8 million. And with respect to the Korean counterpart, payment to KAIST of $1.7 million. So the total payment with respect to the two that was negotiated for those licenses is $8.5 million.

Q. Are there any differences between these two Intel

agreements and the agreement that would result from the hypothetical negotiation that you discussed earlier?

A. Yes, sir, there are. And this next slide summarizes some of those differences. I've talked about some already. So I'll -- I'll go through them quickly.

But when the Intel agreement was negotiated, there wasn't necessarily agreements about infringement and validity. And with respect to the hypothetical negotiation, as I said earlier, the parties agree that the patent is infringed and valid.

At the time back in 2012, P&IB was relative certainly to Intel. It was -- it would have difficulty sustaining in litigation if it wanted litigation, but there wasn't litigation with Intel.

And here today, the Defendants are required to take a license. They can't get up and walk away from the table.

Finally, with respect to this slide, at the time of the Intel negotiation, we've -- we've heard from Dr. Kuhn that there was a fair amount of uncertainty in the industry as to whether even the -- whether the bulk FinFET technology would ultimately be adopted. So there was lack of information about -- about that, as well as whether or not this would prove to be profitable to Intel, whereas, at the hypothetical negotiation, as I've been describing, the parties would be aware of these significant benefits in

terms of profits and cost savings.
Q. How would that affect the negotiating positions of the parties if they had that information in the hypothetical negotiation?
A. Well, it's a completely different picture from the actual negotiation between P&IB and KAIST back in 2011/2012 and the 2015 hypothetical negotiation. It's completely different.
Q. Did you find any evidence of other differences between the Intel negotiation and the hypothetical negotiation?
A. Yes, sir, I did. There's just one more slide on this. At the time of the Intel negotiation, 20-nanometer planar was still under consideration in the industry. But by 2015, as we've heard, 20-nanometer planar had failed. And the industry had moved toward 14-nanometer bulk FinFET. Finally, in the same concept, 2012, Intel was the only entity going forward with bulk FinFET, but by 2015, the industry had adopted it.
Q. Have you seen any testimony from the Defendants about the lack of alternatives to 14-nanometer FinFET?
A. Yes, sir, I have. This is testimony from Mr. Vadi at Qualcomm, and he's saying basically in 2014, if you look at the bottom, the entire industry was going forward bulk FinFET.
Q. Have you seen any evidence that Qualcomm has input in

the manufacturing decisions of Samsung and GlobalFoundries?
A. Yes, sir, we have. This is PX Exhibit 0546. And as one would expect, Qualcomm plays a significant role in designing the chips that it -- that it's involved with. That's indicated on this slide, and at the bottom is a joint press release from Qualcomm and Samsung talking about the fact that they're collaborating on 10-nanometer process technology for the next generation mobile processor.
Q. Did you find any other evidence that the Intel agreement is not -- or that the Intel agreements are not comparable to what would have emerged from the hypothetical negotiation?
A. I did.
Q. What was that?
A. This is PX-0947. And it relates to some emails created at the time of the -- of -- that the Intel agreement was being negotiated. And at the top, we have an email from Mr. Son at KAIST to -- to Intel indicating a -- a willingness to take 30 percent off of its earlier proposal, which had been a hundred million dollars, making it $70 million if they could get to a -- sort of a fast resolution of these conversations or negotiations.
And at the bottom, there's reference to the fact that part of the negotiation about -- about this -- this agreement related to the question of whether or not the patent was valid. That was an issue that was addressed by

the parties at the time.

Q. So you mentioned earlier that one of the differences about the hypothetical negotiation is that the parties will know the -- the future sales and revenue and profits, the incremental profits and cost savings. What would those incremental profits and cost savings be that would be known to those parties at the time of the hypothetical negotiation?

A. Well, what I've done here is summarize those benefits with respect to Samsung and Qualcomm and GlobalFoundries, using the regression analysis results that I obtained, plus the conclusions of Mr. Witt on the speed and power benefits, as well as the 25 percent cost savings figure associated with using bulk FinFET technology.

And so when you summarize all of that, the benefits -- this is not the damages, these are the benefits -- associated with this technology that would be known to the parties at the time of the hypothetical negotiation are approximately $2.7 billion in benefit to Samsung; $2.47 billion to Qualcomm; and $821 million to GlobalFoundries.

Q. And, again, are these just the incremental cost savings and benefits associated with the patent-in-suit?

A. Yes, sir. These are just the additional benefits associated with using the patent-in-suit.

Q. Now, let's -- let's move on to Georgia-Pacific Factor No. 2. Can you tell the jury what that is?
A. Yes. This is sort of similar to Georgia-Pacific Factor 1, but instead of talking about licenses that the patentholder may have entered into, it talks about licenses that involve the potential licensee -- in this case, let's say, Samsung or GlobalFoundries -- for patents that might be comparable to the patent-in-suit. And that's Georgia-Pacific Factor 2.
MR. BUNT: Your Honor, the Defendants have requested that I seal the courtroom or that I ask you to seal the courtroom at this point in time for the next slide.
THE COURT: All right. Based on that request, I'll order the courtroom sealed, which means that anyone present who is not subject to the protective order that's been entered in this case should excuse themselves from the courtroom. In following the practice that we implemented earlier, that includes the corporate representatives and the parties.
All right. For the record, the courtroom is sealed.
(Courtroom sealed.)
(Sealed portion saved in separate sealed transcript.)
(Courtroom unsealed.)

THE COURT: You may continue.

MR. BUNT: Thank you, Your Honor.

Q. (By Mr. Bunt) Mr. Weinstein, did you consider any other agreements as part of your consideration of Georgia-Pacific Factor No. 2?

A. Yes, sir. Samsung produced a number of agreements, and I did have an opportunity to review them. Most of them were lump-sum agreements. There were several agreements that were running royalty agreements, as well, indicating that while Samsung may have a preference for lump-sum agreements, it also occasionally enters into running royalty agreements. I didn't find any agreements that were produced that reflected the kind of power and speed benefits that I've been talking about here.

Q. Did you consider the remaining Georgia-Pacific factors?

A. Yes, sir, I did.

Q. And can you tell the jury your conclusions regarding those factors.

A. Well, what I've listed here are the remaining factors by -- by number. So we've already been through Nos. 1 and 2 and 9 and 10 where I started, and these are the others.

And what I did here is summarize them briefly. Some of them have what I call a downward effect on the agreement. In other words, some of them favor the Defendants in -- in arguing toward a lower royalty, and some

of them have a -- an upward effect.

So just to give an example of two, the geographic scope, that's No. -- Georgia-Pacific Factor No. 3, the geographic scope of the hypothetical license in this case would be limited to the United States. It would not be worldwide.

And other things equal, that's worth less than a worldwide license, and so I treat that one as downward, all right.

Another one that I'll talk about that's downward is No. 5. Sometimes the licensor and the licensee are competitors, and when they're competitors, you don't like to license your technology, and that would have an upward effect.

But in this case we're not talking about competitors so that tends to have an downward effect.

The last one I'll mention is No. 6, and that is a factor that pertains to whether or not the licensee has the ability to make what are called convoyed sales or additional sales that go along with the sale of the product in question.

And so here, if we're talking about smartphones, then Samsung has an opportunity to sell cases or plugs or apps or other things. And so that means that there's an additional benefit that could be associated with using this

technology that's not included just in the damages associated with the phones. And so that has an upward effect.

So I went through all of these with that kind of thought process. And in the end, what I found is that some of these factors were downward; that is, they would tend to produce a lower outcome. Some of the factors were upward, they would tend to produce a higher outcome. And No. 12, there's no information on. There's nothing customary about what fair payment here would be so that's neutral.

And so this is a summary of my consideration of the other Georgia-Pacific factors.

Q. Thank you, Mr. Weinstein.

You've testified about the benefits that the Defendants obtained from using the '055 patent. Did you determine the share of the benefits provided by the patent-in-suit that would go to P&IB at the hypothetical negotiation and what share would go to the Defendants?

A. Yes, sir, I did.

Q. And what share have you concluded would go to P&IB?

A. I concluded that P&IB at the hypothetical negotiation would negotiate for 12 percent of the share of the benefits, and the Defendants would wind up with 88 percent of the benefits.

Q. How did you reach that conclusion?

A. I reached that conclusion going back to one of the emails we looked at, at the time of the negotiation.

But to summarize it briefly, P&IB ultimately accepted $8.5 million for the U.S. license and the Korean counterpart license with Intel in 2012. And $8.5 million is 12 percent of the $70 million that P&IB had been asking for in connection with that license.

And so what I did is I concluded that that agreement, those two agreements reflect the willingness on the part of P&IB to accept 12 percent of what it perceived to be the benefits associated with its licenses.

And so I used that 12 percent here as the share that P&IB would be willing to accept at the hypothetical negotiation with the Defendants.

Q. Mr. Weinstein, before we get to the actual calculation of damages, have you prepared some slides that identify the accused products in this case?

A. Yes, sir, I have.

Q. So if you could briefly tell us what Samsung products are accused?

A. Yes, sir. The Defendants in this case, including Samsung, produced information in the process whereby they identify the accused products.

And so this slide which is from PX-0803, PX-2087, PX-0805, and PX-1985 includes the list of Samsung accused

products. And those are mobile devices on the left, and then 14-nanometer Exynos chips, 14-nanometer Snapdragon chips, 14-nanometer Nvidia chips, and then chips sold to Apple.
Q. And then what Qualcomm products are accused?
A. Qualcomm products are shown on PX-0803, and these are 14-nanometer Snapdragon chips.
Q. And then what GlobalFoundries products are accused?
A. Take several pages to include all of the GlobalFoundries products. It's PX-0821. But these are 14-nanometer AMD chips, and 14-nanometer Exynos chips, and 14-nanometer Snapdragon chips.
Q. Finally, Mr. Weinstein, let's turn to your damages calculations. And can you please walk the jury through how you went about calculating damages?
A. Yes. In this next slide is a summary of unit sales of all Samsung infringing products between November 29th, 2016, May 14th, 2018, that's the damage period that I've been using for purposes of my calculation.
And so on this slide, one sees for 14-nanometer products, each category of sales made by Samsung.
Q. So for smartphones with Exynos chips, how many unit sales were there?
A. 1,022,562.
Q. And is this the amount received by Samsung for those

smartphones, or is that just unit sales?
A. No, those -- those are the sales.
Q. Okay.
A. Those are the sales.
Q. And then for the tablets with Exynos chips, what were the unit sales?
A. Unit sales for tablets with Exynos chips are 1,289,678.
Q. And for smartphones with the Snapdragon chip?
A. 7,292,550.
Q. And for Samsung tablets with the Snapdragon chip?
A. 343,142.
Q. And for Exynos chips that were sold alone?
A. 245,000 -- 245 million -- excuse me, I'll start again.
245,656,852.
Q. And where did you get this information from?
A. This information was made available to me from documents that were produced by Samsung in connection with this litigation.
Q. And what do you call this -- this combination of numbers?
A. I -- I probably call it the damage base.
Q. Okay. What did you do with this damage base?
A. So what I did with the damage base is I calculated the incremental benefits per unit, which come from the regression analysis and Mr. Witt's conclusion, and I applied

to it the share of those benefits which I have concluded would have gone to P&IB at the hypothetical negotiation.

So an example of that calculation is set forth on this next slide, and the incremental speed profits per unit when I used Mr. Witt's conclusion about the 20-percent benefits and my regression results of $1.06, amounts to $21.22, multiply that times the 12 percent to get the speed damages rate benefit that P&IB would have negotiated for that 12 percent.

And at the bottom I do a similar calculation with respect to the power benefits. And, again, P&IB's share is 12 percent.

So the power efficiency benefits that would be negotiated using that 12-percent figure by P&IB are 2.19.

And then the next step will be to add those up because they're separate.

Q. Before we go to the next step, just so we're -- at the top of this slide, the incremental speed profit per unit, that's the total incremental speed profits that Samsung has realized from using the patent-in-suit?

A. Yes, sir, I believe that's a conservative estimate.

Q. And then the 12 percent you're saying that you multiply there, that's the amount that's going to be allocated as a part of this hypothetical negotiation to KAIST, correct?

A. Correct.

Q. And then you've done the same numbers below that for the incremental power efficiency profits, right?
A. I have.
Q. So what's the total speed and power efficiency damages rate for smartphones?
A. Well, as I said, the next step would be to add those two up, and so I've done that on the next slide, I've added the two. And the total rate is $4.74.
Q. And then did you do similar calculations with respect to Samsung tablets and Samsung Exynos system on chips?
A. I did. And so this next slide is a summary for Samsung of the damages per unit rates that I've calculated for smartphones, and that's the $4.74 rate that we just looked at for tablets and for Exynos chips. And in the middle column, I've -- I've shown the rate per unit that I believe P&IB would have negotiated for. And in order to calculate damages, you multiply that rate, which is 12 percent of the entire benefit, times the number of units that are shown on the left. And when you do that total, Samsung speed and power efficiency damages are $219,936,743.00.
Q. Now, that's for speed and power efficiency damages. What about for cost saving damages -- cost savings damages?
A. Cost savings damages are separate, and so that's a separate calculation. That has to be added to these.
Q. So how did you go about calculating those costs?

A. I took the 25 percent figure of cost savings that -- that we heard testimony about, and I applied that to Samsung's direct cost associated with manufacturing 14-nanometer bulk FinFET.
Q. And then can we go to Slide No. 50, and can you show us how you calculated the cost savings for Samsung?
A. Right. We know that those cost savings are 25 percent -- cost savings are 25 percent, but since the cost that we're talking about or that we're looking at in this period have already reflected the benefit associated with the cost savings, when you look at this exhibit, the cost savings attributable to the '055 patent are going to be essentially a third of the cost that are shown. And that's because of the -- of the way in which the math works out when you have 25 percent cost savings.
So I took those 25 percent cost savings, which are shown on Line 2, and I multiplied times the share that P&IB would have negotiated for, 12 percent, and so the total cost savings on -- to Samsung and P&IB's share would be $101,501,708.00.
Q. And, again, are these cost savings damages separate from the speed and power efficiency damages that you calculated earlier?
A. Yes, sir, they are. They should be added to the other damages.

Q. So what are the total damages owed to KAIST by Samsung for use of the patent-in-suit?
A. This next slide depicts that total. You have the speed and power damages of roughly 219 million. The total cost saving damages of another 101 million. For total damages owed by Samsung for the period November 29th, 2016, to May 14th, 2018, of 301 -- $321,438,451.00.
Q. What does Samsung get to keep?
A. Well, it gets to keep almost 2.4 billion. Those are the -- that's its 88 percent share of the benefits. So Samsung gets to keep approximately 2.4 billion of the incremental speed and power savings benefits.
P&IB gets to keep -- or negotiates for 321 million. So P&IB gets 12 percent. Samsung gets 88 percent.
Q. How about for Qualcomm?
A. Qualcomm, I used the SoC rate of 93 cents per unit, applied that to the -- what I'll call the damage base of accused units. And so total speed and power damages for Qualcomm are $296,851,609.00.
Q. And what amount does Qualcomm keep?
A. So Qualcomm here gets to keep approximately $2.2 billion. That's its 88 percent share.
P&IB gets to keep 296 million.
Q. And for GlobalFoundries?
A. GlobalFoundries, it's a pure cost savings. And so I

took the share that I believe P&IB would have negotiated for -- namely, 12 percent of the $821 million -- and so the cost savings damages associated with GlobalFoundries are $98,541,744.00.

Q. And what would GlobalFoundries keep?

A. GlobalFoundries would keep approximately $722 million. That's its 88 percent share.

P&IB would keep approximately $98 million. That's its 12 percent.

Q. So one final summary, Mr. Weinstein. Can you please tell the jury what the minimum damages are to compensate KAIST for infringement by Samsung of the patent-in-suit?

A. I've concluded that the minimum damages to compensate KAIST for infringement by Samsung of the patent-in-suit for the period of November 29th, 2016, to May 14th, 2018, are $321,438,451.00.

Q. And can you tell the jury what the minimum damages are to compensate KAIST for infringement by Qualcomm of the patent-in-suit?

A. Damages adequate to compensate for infringement by Qualcomm amount to $296,851,609.00.

Q. And can you please tell the jury what the minimum damages are to compensate KAIST for infringement by GlobalFoundries of the patent-in-suit?

A. Damages adequate to compensate KAIST for infringement by

GlobalFoundries amount to $98,541,744.00.

MR. BUNT: I pass the witness.

THE COURT: Cross-examination?

MR. KENNERLY: Yes, Your Honor.

THE COURT: Proceed when you're ready, Mr. Kennerly.

MR. KENNERLY: Thank you, Your Honor.

CROSS-EXAMINATION

BY MR. KENNERLY:

Q. Good afternoon, Mr. Weinstein.

A. Good afternoon.

Q. We meet again.

A. We do.

Q. You'd agree Plaintiff is not seeking damages for any time before the filing of this lawsuit; is that right?

A. Yes, sir.

Q. You understand the Defendants deny they infringe and assert the patent is invalid?

A. I do.

Q. And you understand it's Plaintiff's burden to prove infringement?

A. That's my understanding, yes, sir.

Q. And you understand if the jury finds no infringement, Plaintiff is not entitled to any damages?

A. Correct.

Q. And you understand if the jury finds the patent is invalid, Plaintiff is not entitled to any damages?
A. Yes, sir, that's also correct.
Q. Now, you relied on Dr. Kuhn's opinion and Mr. Witt's opinion; is that right?
A. I did, yes, sir.
Q. And would you agree their opinions on which you rely were important to your opinions?
A. Yes, sir.
Q. Would you agree if Dr. Kuhn is incorrect that the incremental benefits of the accused 14-nanometer FinFETs are solely attributable to the '055 patent, that your damages opinion is overstated?
A. I would agree that if her opinion is incorrect, my damages results would also be incorrect.
Q. And similarly, if Mr. Witt has overstated the percentage improvements that he testified about, would you agree that your damages are overstated?
A. I would.
Q. Regarding the Intel license which you talked about, you would agree that valuing the patent based on real-world comparable licenses is typically reliable because the parties are constrained by the market's actual valuation of the patent, fair?
A. Yes, fair.

MR. KENNERLY: Can we pull up DX-526, please, Mr. Dahm?
Q. (By Mr. Kennerly) Sir, this is the patent license agreement between P&IB, Professor Jong-Ho Lee, and Intel involving the '055 patent, correct?
A. Yes, sir.
Q. And would you agree this is the only actual real-world license to the '055 patent?
A. I would -- I would agree to that, yes, sir.
Q. And so no dispute, the Intel agreement and the hypothetical negotiation in this case involves the same licensors -- that is, P&IB and Professor Lee?
A. That's fair.
Q. And the very same patent, right?
A. Yes, sir.
Q. Exact same claimed invention, right?
A. Correct.
Q. And would you agree that this Intel agreement is certainly relevant here and should be considered with respect to damages in this case?
A. I do.
Q. The agreement here was entered into in late 2012 -- on September 27, 2012, right?
A. Yes, sir.
Q. And the hypothetical negotiations with each Defendant in

this case would have occurred in late 2014 or early 2015, right?
A. That's -- that's fair, yes, sir.
Q. Okay. And you're not aware of any reason why the outcome of your analysis would be different if the hypothetical negotiation had occurred in late 2014 versus early 2015, right?
A. Yes, sir.
Q. And would you agree there's a difference of about two years between the Intel agreement in late 2012 and the hypothetical negotiation in this case?
A. I do.
Q. Now, you understand P&IB is a patent licensing company, among other things?
A. Yes, sir.
Q. And in that role, P&IB is seeking to make the best possible deals it can for its clients, obtain the highest possible license fees it can, right?
A. Correct.
Q. And you'd also agree P&IB and Professor Lee, by licensing the patent to Intel, showed their willingness to license the patent?
A. I agree with that.
Q. And this agreement, as you testified, Intel paid $6.8 million for its rights to the '055 patent, right?

A. Yes, sir.
Q. And would you agree that P&IB and Professor Lee received that as a fully paid-up lump-sum royalty, and there were no running or ongoing royalties owed?
A. Correct.
Q. Would you agree a lump-sum royalty is a common form of royalty in patent license agreements?
A. Yes.
Q. Would you agree that the $6.8 million royalty for the license to the '055 patent, that amount represented a fair market value in the context of information available to those parties at the time?
A. I -- I generally agree with that, yes, sir.
Q. This Intel agreement did not give Intel rights to any other patents or patent applications, any other technology or know-how besides just the '055 patent, right?
A. True.
Q. In the same way the hypothetical negotiations in this case would involve only negotiations about the '055 patent, not any other patents or other technology or know-how?
A. Correct.
Q. And in this agreement, Intel was granted non-exclusive rights to the '055 patent, meaning P&IB and Professor Lee could still go out and license the patent to other companies?

A. That is correct.
Q. And you'd agree that's in contrast to a sale -- sale of the patent where P&IB and Professor Lee could never license the patent to anyone else?
A. Sure, that's true.
Q. And for that reason, buying a patent outright usually costs more than buying a non-exclusive license?
A. Other things equal, yes.
Q. Other things equal, owning the patent is worth more than just a license, right?
A. Sure.
Q. And just as in the Intel agreement in the hypothetical -- hypothetical negotiations in this case, each Defendant would be negotiating only for non-exclusive rights?
A. Correct.
Q. Would you agree that Intel was granted rights under the patent to make and sell its own chips?
A. As far as I know, yes.
Q. And in this agreement with Intel, because of that, the royalty was paid at the chip or the -- the wafer manufacturing level -- that is, from Intel and not from Intel's customers; is that fair?
A. Well, the royalty was -- the lump-sum payment was from Intel, that's true.

Q. Would you agree that after licensing Intel, based on the terms of this agreement, that P&IB and Professor Lee couldn't go after more royalties from Intel's customers?
A. As far as I know, that's right.
MR. KENNERLY: Can we pull up Section 3.4, please, Mr. Dahm?
Q. (By Mr. Kennerly) Mr. Weinstein, this is Section 3.4 of the Intel agreement, DX-526.
And if you look at this, would you agree with me that based on this agreement, customers of Intel would be free to use the patented rights and that P&IB and Professor Lee would not have an ability to go seek more royalties from Intel's customers?
A. That seems to be what it says, yes.
MR. KENNERLY: Can we pull up Section 3.1, please, Mr. Dahm?
Q. (By Mr. Kennerly) This section describes the licenses granted to Intel. Do you see that?
A. I do.
Q. And do you see in Section A, Intel is granted the right to make, use, sell, offer to sell, import, otherwise dispose of the licensed products?
A. I see that, yes, sir.
Q. And to be clear, the -- the licensed products of Intel included its bulk FinFET chips, right?

A. Yes, sir.
Q. Okay. You see here also Intel was given the right under Section B to make, have made, use, et cetera -- given other rights, for example, to have another company make chips on its behalf. Would you agree?
A. Yes.
Q. So, for example, Intel acquired foundry rights under this agreement. It could make chips and sell them to others, and it also had the right to have someone make chips for it; is that fair?
A. That seems to be true, yes.
Q. Referring to Section C, again, we see have made rights. Do you see that?
A. I do.
Q. And is that consistent with your prior answer?
A. I believe so.
Q. Now, in the hypothetical negotiation with the Defendants, Qualcomm would be getting these same rights for its chips -- that is, to have them made by other companies like Samsung and GlobalFoundries, right?
A. Well, it would have the right to use -- use the technology. In other words, it would have a right to the 14-nanometer technology.
Q. And its rights would include the ability to -- to have that technology made for it by, say, Samsung and

GlobalFoundries, rather than making those chips itself, right?
A. Presumably, yes.
Q. Well, it's clear, isn't it?
A. Well, that's a -- that's an interesting point about a hypothetical negotiation. It usually doesn't get too much further than just the rights, but that seems to be fair, yes.
Q. Well, Qualcomm in that hypothetical negotiation would be similar -- similarly situated -- that is, what rights would it need -- if it would need the right to have Samsung and GlobalFoundries make chips for it, those same type of rights are what Intel was granted in the -- in the actual license that we're looking at, fair?
A. That seems fair, yes.
Q. Now, you understand Qualcomm never makes any of the accused chips in the U.S., right?
A. I do.
Q. And you understand Qualcomm never sells any of the accused chips in the U.S., right?
A. As far as I know.
Q. Would you agree that in this case, for each Qualcomm chip or system on a chip that's accused, if -- if Plaintiff fails to meet its burden to prove that Qualcomm actually made those chips in the U.S. or sold them in the U.S. or

imported them into the U.S., there cannot be any damages as to such a chip?
A. That sounds right.
Q. Would you agree that the vast majority of your claimed damages as to Qualcomm are for chips that it never makes, never sells, or never imports into the U.S.?
A. I believe so.
MR. KENNERLY: Now, if we can pull up Section 6.1 of the agreement, please?
Q. (By Mr. Kennerly) This regards the term of the agreement, and you understand this agreement gave Intel rights through expiration of the patent in 2023?
A. Yes, sir.
Q. And given the time of the hypothetical negotiation in late 2012, that's about 11 years?
A. That's fair.
Q. In the hypothetical negotiation in this case, Defendants would be negotiating a license for a shorter time, through the life of the patent from late 2014, early 2015, right?
A. That's true.
Q. About eight years?
A. That's fair.
Q. Okay. So we're comparing eight years versus 11. Would you agree that all else being equal, a longer license is worth more than a shorter -- shorter license?

A. I do.
Q. I think I saw this in your slide deck. I think it was Slide 34. But you would agree at the time of the hypothetical negotiation in this case, Intel had launched its 22-nanometer bulk FinFET products, right?
A. Yes.
Q. And you would agree at the time, Intel was the largest American semiconductor manufacturer?
A. I believe so, yes.
Q. And so it was known with a hundred percent certainty at the time of the Intel agreement, DX-526, that Intel had launched those FinFET chips, right?
A. Now, you're talking about 2012, the Intel agreement?
Q. Right.
A. Yes.
Q. Okay. So to be clear, at the time of the Intel agreement between P&IB, Professor Lee, and Intel, all those parties knew with certainty that Intel had already launched its 22-nanometer FinFET products?
A. I believe so, yes.
Q. You're familiar, I believe, from your work in this case with a number of articles and other public information describing Intel's announcement of its 22-nanometer FinFETs in 2011, the build out of fabs, and the launch of those products in, say, the first half of 2012; is that fair?

A. I believe so, yes.
Q. At the time of the Intel license, if it had switched from its 22-nanometer bulk FinFET device technology to some other technology to avoid using the patent, if that were necessary, it wouldn't surprise you if the cost of that would be in the -- the billions of dollars; is that fair?
A. Well, it would depend on whether -- I can't answer that question as is.
Q. Fair point. Fair point. Let's move on.
All the facts that we described about Intel, and essentially the fact that it was -- it had launched in 2012, was in large scale mass commercial production, that would have been known to the parties that entered that license agreement -- that is, to P&IB and Professor Lee, right?
A. I believe so, yes.
Q. At the time Intel launched production of its bulk FinFET devices in -- in early 2012, would you agree, based on what you've heard in this case, that at least Professor Lee also knew at the time that Samsung planned to mass produce bulk FinFET devices?
A. I can't speak to that.
Q. Okay. You -- you've sat in for the duration of the trial?
A. I have.
Q. Did you hear Professor Lee's testimony?

A. I did.
Q. You're unable to say whether he knew that Samsung planned or intended or anticipated to mass produce bulk FinFET devices?
A. I'm -- I'm sorry, I can't.
Q. Okay. Would you agree the Intel license agreement does not state any requirement that Intel mark its licensed products with the '055 patent number?
A. I don't know.
Q. You've certainly reviewed the agreement?
A. I did.
Q. You just don't recall as to that point?
A. Correct.
Q. Would you agree that nothing in the Intel agreement restricted its use of the '055 patent to a particular node or generation of FinFET so it purchased a license not only for its 22-nanometer bulk FinFETs but also for future smaller nodes of those FinFETs?
A. Yes, I agree with that.
Q. And would you agree that in contrast in the hypothetical negotiations in this case, the negotiation would only be centered -- centered around what's accused -- that is, the 14-nanometer node?
A. That's fair.
Q. And each Defendant would only be negotiating for rights

to that 14-nanometer node, as opposed to other nodes in the future?
A. Yes.
Q. And all other things being equal, a 14-nanometer only restricted license that each Defendant would -- would be negotiating for would be less than the unrestricted license of the type that Intel paid for?
A. Correct.
Q. Would you agree that -- well, strike that, please. We've heard about alleged benefits of the patent or the patented technology from -- from others. Regarding those alleged benefits, broadly speaking, would you agree that the benefits would be similar for Intel as for the Defendants in this case?
A. Well, you said broadly speaking. I guess the -- the answer to that is to some extent. I mean, Intel is in a slightly different business from the Defendants. Intel doesn't make smartphones and tablets. So there -- there are some similarities and some differences.
Q. You're speaking about different intended market segments as between Intel and -- and, say, Samsung?
A. In -- in that case, yes.
Q. Putting aside that market segment issue, would you agree that broadly speaking, the -- the benefits -- the technical benefits would be similar for Intel as far the Defendants?

A. Well, broadly speaking, the technical benefits would be similar, I agree with that, but you can't really put aside the -- the market segments.
Q. Understood. Now, you're -- you're aware that in the -- in the negotiations with Intel, P&IB and Professor Lee took the position that Intel's bulk FinFET devices infringed?
A. They did.
Q. And you know Intel told them it disagreed that its bulk FinFETs infringed, right?
A. I'm aware of that.
Q. Now, this was at a time that Dr. Kuhn was at Intel. Do you understand that?
A. I do.
Q. Would you agree that in the -- in the negotiation documents with Intel -- that is, the licensing history that's been produced in this case -- P&IB and Professor Lee, the licensors, never expressed any doubt about whether Intel infringed?
A. That's my best recollection, yes.
Q. You haven't seen that in the email correspondence, for example?
A. I haven't seen them expressing doubt about Intel using the technology, that's true.
Q. Now, as you testified, Intel ultimately agreed to two licenses, one for the '055 patent for a fully paid up lump

sum of $6.8 million, and the other for the Korean counterpart patent for a fully paid up sum -- lump sum of $1.7 million, right?
A. Correct.
Q. So the total was $8.5 million?
A. Correct.
Q. And 80 percent of that was for the '055 patent -- that is, $6.8 million?
A. Yes.
Q. And the other 20 percent was for the Korea patent, $1.7 million?
A. True.
THE COURT: Counsel, approach the bench, please.
(Bench conference.)
THE COURT: Mr. Kennerly, where are you in your cross as far as remaining time?
MR. KENNERLY: For time, I'm probably a third of the way.
THE COURT: So what would your -- what would your best estimate be about remaining time in number of minutes?
MR. KENNERLY: Half-hour -- half-hour, 40 minutes tops.
THE COURT: All right. I'm not going to keep the jury that late. We're already at a quarter till 7:00. We're going to recess for the day. You can finish in the

morning. And then if there's redirect, we'll take it up then.

(Bench conference concluded.)

THE COURT: Ladies and gentlemen, this examination has apparently some additional time to go, and it's getting late in the evening. I'm not prepared to keep you any later tonight. So we're going to recess for the day at this time.

I'm going to ask you to -- as you leave the courtroom, to go through the jury room and leave your closed notebooks on the table in the jury room on the table there. I'm going to remind you to follow all my instructions, including not to discuss the case with anyone in any way. Please travel safely to your homes.

And I'd like to have you back tomorrow morning, just like today, about 8:15, assembled and ready to go so that we can start as close to 8:30 as possible. Travel safely, ladies and gentlemen. You're excused for the evening.

COURT SECURITY OFFICER: All rise for the jury.

(Jury out.)

THE COURT: Be seated, please. Counsel, I've looked at your previous submissions with regard to the proposed final jury instructions and verdict form. And given the presentation of the evidence to this date, it appears to me that the parties and the Court could

both benefit with a revised submission concerning your proposed final jury instructions and verdict form. So I'm going to direct and order the parties to meet and confer and submit an updated proposed final jury charge and verdict form not later than 3:00 p.m. tomorrow afternoon. Obviously, if there are areas of disagreement, you'll submit both competing areas in the same document.

And I'm also going to direct that you email a copy of that submission, both as to the final jury instructions and the verdict form, to my law clerks in a Word format by the same time tomorrow afternoon.

Are there other matters that either Plaintiff or Defendants are aware of that we need to take up before we recess -- or before we recess for the day?

Is there anything further from the Plaintiff?

MR. BUNT: No, Your Honor.

THE COURT: Anything further from Defendants?

MR. JACOBS: Not from the Defendants, Your Honor.

THE COURT: I will be in chambers by 7:30 against the prospect that there may be disputes develop overnight that can't be resolved. I will remind you that the Court's expectation is that you seriously meet and confer and fully communicate in an attempt to minimize such late-breaking disputes. But if they are unable to be avoided, you're to advise my staff, per the existing practice, and I'll be

available to meet with you in the morning before we bring the jury in and address those.

Likewise, in the morning, as we did today, before I bring the jury in, I'll expect each side to offer a recitation of those items from the list of pre-admitted exhibits that were used before the jury during today's portion of the trial.

Unless there's anything else, we stand in recess until tomorrow morning.

COURT SECURITY OFFICER: All rise.

(Recess.)

CERTIFICATION

I HEREBY CERTIFY that the foregoing is a true and correct transcript from the stenographic notes of the proceedings in the above-entitled matter to the best of my ability.

/S/ Shelly Holmes
SHELLY HOLMES, CSR, TCRR
OFFICIAL REPORTER
State of Texas No.: 7804
Expiration Date: 12/31/18

6/12/18
Date